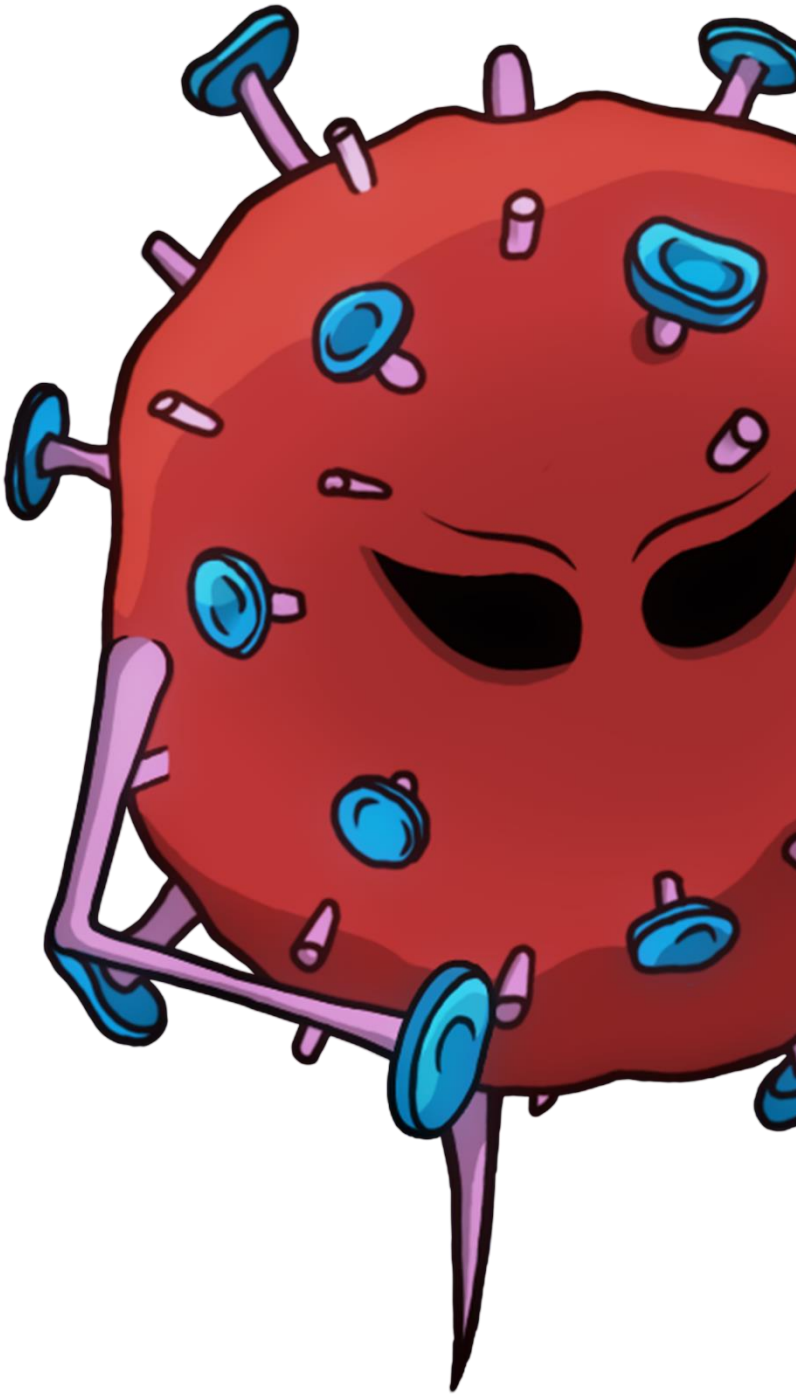
Battle in the Blood
Development of a Mobile Game to Increase Uptake of HIV Services Among Young Key Populations in the Philippines: Mixed Methods Case Study

Thesis submitted in accordance with the requirements of the University of Liverpool and the Liverpool School of Tropical Medicine for the Degree of Doctor of Philosophy

By Charlotte Hemingway
August 2021



Declaration

I hereby declare that this PhD thesis is a presentation of original work.

Material contained herein has not been previously published, accepted or presented for the award of any University degree. Every effort has been made to acknowledge the contribution of others.

Download Battle in the Blood

“I have no one to share the bed, I don’t have someone to talk to… so the game would remind me that if I was able to introduce this to him earlier, maybe I’d still be with him.” – ***Battle in the Blood Player, 28 years old***

Acknowledgements

I hereby dedicate this thesis to the inspirational HIV GET Tested project team.

To my colleagues and new-found friends at the University of the Philippines, College of Medicine; Emmanuel S. Baja, Ernest G. Guevara, Jody V. Dalmacion, Paul Mark B. Medina and Tyrone R. Sy. For your support, your guidance, and for welcoming me into your home and lives.

To the talented development team at EM Studios; Bobby Farmer (co-producer), Craig Gardiner (lead artist), Aitor Prado (lead coder), Stuart Henderson (coder). For bringing our vision for Battle in the Blood to life.

To my supervisors and mentors at the Liverpool School of Tropical Medicine (LSTM) and the University of Liverpool, Miriam Taegtmeyer (lead supervisor), John Blakey (secondary supervisor), Euphemia Sibanda (secondary supervisor), Russell Dacombe (line manager), and Marlize Coleman (mentor). For your intellectual guidance and for giving me the tools to pursue my ambitions.

I would not be where I am today without your support and it has been a privilege to be a part of the team.

To the participants. For sharing your stories. For your passion and energy during the user centred design process and for taking on the infamous Manila traffic to meet with me and share your valuable knowledge. To the healthcare workers at LoveYourself, Klinika Bernardo and Davao Reproductive Health and Wellness Centre. For your unwavering support and valuable insights.

And finally, for everyone who has shared a drink or a good meal with me and taken the time to offer guidance and praise.

Abstract

Background

While progress has been made against the UNAIDS 90-90-90 targets, public health gains made in the adult population continue to elude adolescent and young key populations. Progress is not the same in all countries with the Philippines experiencing a sharp rise in HIV infections among young key populations with limited uptake of testing and treatment services. Behaviour change is key to addressing these issues and interventions targeted at this cohort need to be relevant and engaging to successfully compete for their attention, change perceptions, and encourage positive health-related behaviour. The advent and popularity of mobile gaming in the Philippines position digital behaviour change games as a promising platform. Through gameplay, users can traverse a carefully constructed narrative, exposing them to new perspectives around HIV and increasing knowledge of early signs of HIV infection, risk behaviours and available testing and treatment services. While the use of digital games for HIV prevention and detection has rapidly increased in recent times, little is known about game development and effectiveness in low and middle-income (LMIC) contexts. In addition, evidence through randomized control trial design of the effectiveness of games underpinned by cognitive theories of behaviour change is weak, denoting a need to re-think the contribution of these games to the health development field and how we evaluate them.

Study Aim

To explore the contribution and limitations of a tailored digital game for health aimed at improving HIV-related knowledge, attitudes and practices among young key populations in the Philippines.

Objectives

1. To identify appropriate learning objectives and theoretically driven game design relating to HIV prevention and control among young key populations in the Philippines.
2. To develop a playable and acceptable behaviour change game targeted at young key populations in the Philippines.
3. To assess demand and reach of the game among target users.
4. To explore the effect of the game on cognitive and social determinants of HIV service use and behaviour.

Methods

A mixed methods approach was taken to establish a theoretically driven, evidence-based game design and explore its acceptability and effect among target users. All primary data were collected in the Philippines between August 2016 and December 2018.

A literature review was combined with formative work in the Philippines to determine the intended learning and behaviour outcomes of the game. The formative work comprised: 1) semi-structured qualitative interviews with men who have sex with men (MSM) and transgender women (TGW) in the National Capital Region (NCR) to inform the learning objectives; and 2) a retrospective review of attrition along the HIV care cascade conducted at four HIV testing and counselling clinics (three in the NCR and one in the Davao Region). An additional review of games for health literature underpinned the development of a conceptual framework to inform the game design and evaluation.

The game was developed through an iterative user-centred design process: game design (November 2016 to February 2017), prototype testing (August 2017 to November 2017) and game analytics (December 2017 to December 2018). The game was built by a UK developer with input from a UK physician and Filipino physician, nurse, virologist and epidemiologist. During the game design and prototype testing activities, a total of 40 Filipino participants comprising target users and trained HIV counsellors engaged in participatory design workshops, extended playtests and focus group discussions. Battle in the Blood (BitB) was launched on the app store on World AIDS day in December 2017. In-game events, captured through the Unity Analytics service (v.2017.1), were utilised to monitor uptake of the game and identify any access or playability issues over a 12-month period. Findings from the development and roll out of the game were supplemented with quantitative findings from two data sources: 11 months' pre and post-game launch of clinic registration data from three study clinics[1]; and a survey administered at the clinics to record game use among clients. In-depth qualitative interviews were conducted with 25 BitB users to explore the game's effect on cognitive and social determinants of HIV service use.

Results

Literature review and formative work

The literature review and formative work combined to focus the game's learning objectives on benefits of knowledge of status. Representative population data revealed low rates of testing among young key populations. The baseline assessment revealed that study clinics were operating close to capacity; that the vast majority of clients coming to the clinics reported as MSM or TGW; and that certain HIV-infected populations were not engaging with their services and the availability of timely HIV treatment for reactive clients.

The literature review and qualitative formative research strongly indicated that elevating perceived risk of HIV-infection alone is not sufficient to increase engagement with HIV

[1] Data collection activities at one of the clinics in the NCR ceased in March 2018 after an unexpected loss in funding resulted in Quezon City Council drastically limiting HIV services at the clinic for an extended period and no longer had the capacity to support the study.

services; a successful behavioural intervention needed to address the fears of positive diagnosis and knowing one's status by offering an optimistic narrative of life after diagnosis with treatment, with practical information on where to find quality free and confidential HIV testing services and social support in attending the clinics. Findings from the qualitative research informed the learning objectives. The conceptual framework posits that the game's content and learning objectives will directly affect key predictors of behaviour change; however, the ability for the user to act on new intentions would remain dependent on external conditions not influenced by the game e.g., availability of testing services [Figure 0-1]. The targeted behaviour was defined as undergoing HIV testing and counselling from a legitimate provider when the individual perceives they are at risk, with timely linkage to care if reactive.

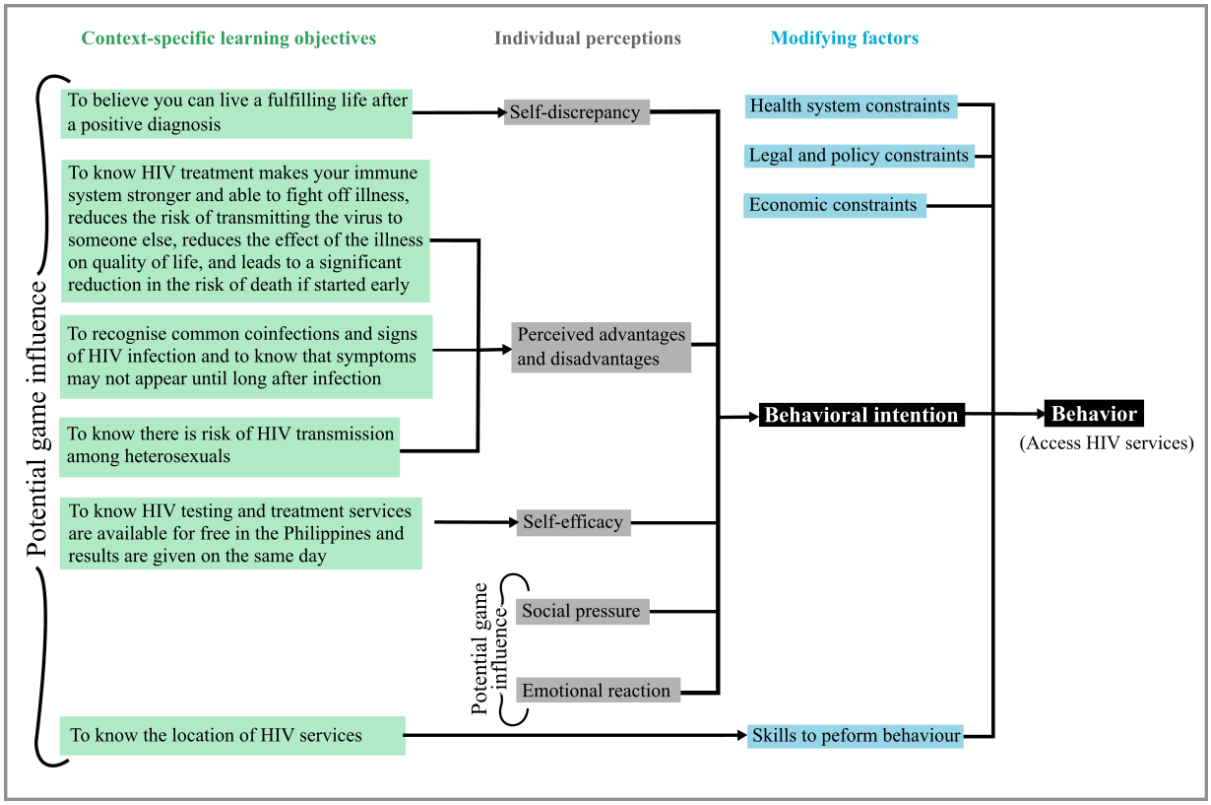


Figure 0-1: Conceptual framework for the game

Game acceptability

The game was found to be acceptable during prototype testing. By involving target users from the outset, the development team were guided towards relatable and understandable narratives and enjoyable gameplay. The resulting product was a game that was accessible and entertaining due to universally recognised game mechanics, with low storage requirements and offline gameplay. The experience of playing the game and participating in discussions around the in-game narratives resulted in positive changes in reported knowledge and perceived stigma among game testers.

In the 12-months following game launch, out of 3,325 total users, geolocation data was collected for 1,688 users, of which 1,441 (85.4%) were in the Philippines.

As of 01/12/2018, analytics data reported that 15% (498/3325) of users completed level 45 and 4% (133/3325) completed level 90, the final level. While gameplay being perceived as repetitive and having limited appeal were believed to be factors contributing to low rates of game completion, the figures were affected by missing completion data due to offline gameplay.

Exploring game effect

The game had limited effect at scale but did effect behaviour through the interplay between gameplay and social interactions. Of the 25 game users interviewed, a majority identified as HIV service providers, medical students, PLHIV and LGBTQ+ advocates. For many of these users, the game was not a catalyst for behaviour change as it reaffirmed their existing beliefs. However, there was evidence of the game providing social capital as a jovial and reputable mechanism to introduce the topic of HIV to their peers and family. For one user, the game provided the tipping point in their decision to access HIV testing and treatment services. He was encouraged to play the game by his sexual partner who died before the interview took place from suspected AIDS complications. He reported that, during his grief, the game's narrative helped him cut through the denial and precipitated the act of going to a clinic to confirm his status and access treatment.

Research activities at the study clinics indicated that the game was not a major contributing factor to uptake of HIV testing services among young key populations. Trend analysis of the monthly clinic register data suggest that HIV testing uptake remained consistent at the study clinics in the NCR. In Davao there was a noticeable increase in testing uptake shortly after game launch and the World AIDS Day celebrations taking part in the region, but this increase was not sustained in the months following.

A voluntary survey, implemented to track game use among clients at the study HIV testing and counselling (HTC) clinics, indicated a link between discovering the game through a friend and the game playing a role in clinic attendance, pointing towards an interplay between game effect and the users' support systems and social context.

Discussion

Guiding principles for game design and development

Games for health development can be characterised as a process involving highly interdependent tasks under conditions of uncertainty and resource constraints; because of this, efficient and quality game development requires effective communication and relationship dimensions in the development team; frequent, timely, accurate, problem-solving communication, and relationships of shared goals, shared knowledge and mutual respect. Further to this is to ensure members of the development team have clearly defined roles relevant to their area of expertise.

This study highlighted the importance of consulting target users at multiple stages of the development process, aligning methods with the development stage and design questions. Game development can be considered as a vast collection of decisions. Some of these decisions become immoveable pillars of the game design such as the game genre. Think of these decisions as pegs in a pachinko and the players as the balls. Players bounce around these decisions in unpredictable ways, eventually falling into categorised levels of engagement e.g., bored or enthralled. Involvement of target users during development enables observation of their trajectory and the movement of some pegs to ensure most players fall into a positive level of engagement, but the success of the game cannot be determined until vast numbers of players are poured in. Game testing at this scale often comes after a point when big pillar decisions have been made that are structurally hard to shift. Game development projects should be structured with this in mind, ensuring adequate resources for iterative design and design cycles that involves feedback from large numbers of players.

Increased reporting of design approaches and stronger collaboration between health professionals, the entertainment games industry and end users will support the games for health industry as it matures. Restructuring projects to involve users prior to determining the development budget will enable design choices to be driven more by user requirements and less by what is feasible.

New insights on game evaluation

There is strong appeal and demand for digital behaviour change games in the health development field, but the evidence indicates that these games are not the *silver bullets* they are at times portrayed to be. Where a game simply repackages health information in a bid to increase knowledge and change perceptions, its potential to change behaviour lies in the social capital it generates and whether the bounded context surrounding the game is conducive to behaviour change. Behaviour change games should therefore be thought of as tools within a wider health systems strengthening approach to increase health seeking behaviour and improve health outcomes.

The health development field is increasingly looking beyond trial outcomes to a systems-based approach to consider the effectiveness of interventions within the local environment. Health behaviours are the emergent product of cognitive determinants, social field habitus and doxa, structural and economic determinants and policy environments. The complexity of health behaviour precludes the needs for a systems thinking and multidisciplinary approach. Future research should attempt to understand how a behaviour change game functions within its real-life context and identify factors that mediate its impact on health behaviours or outcomes.

Important design considerations for behaviour change games

In the case of BitB, qualitative evidence demonstrated an appreciation of the topic addressed in the game and the health messages it communicated. There were instances where the game

acted as a catalyst for important conversations around HIV which led to positive health-related action being taken. Digital gameplay as an activity does not occur in a vacuum, users talk about games, share strategies and participate in a gaming community which can span multiple media platforms. Social interactions triggered through gameplay may provide opportunities beyond the games content to effectively influence and change behaviour. As an individual's behaviour is associated with social pressure, the social context of gameplay is an important design consideration. The desired social effect of the game should be defined in the initial design stages and underpinned by theories of behaviour change and game design.

In addition to social aspects, narrative is an important design consideration in behaviour change games. Storytelling has long been established as an effective means of attitude and behaviour change and this was reflected in findings during the user-centred design process for BitB. This also highlights the importance of having an experienced narrative designer as part of the development team to work in partnership with subject domain and behavioural experts.

Contents

List of Tables

List of Figures

List of Acronyms

AMTP	AIDS Medium Term Plan
ART	Anti-retroviral therapy
ARV	Anti-retroviral
BitB	Battle in the Blood
CHW	Community health worker
DAU	Daily active user
DoST	Department of Science and Technology
DRHWC	Davao Reproductive Health and Wellness Centre
FGDs	Focus group discussions
FSW	Female sex workers
GDD	Game design document
GDPR	General Data Protection Regulation
GPS	Global positioning system
HARP	HIV/AIDS Registry
HCV	Hepatitis C virus
HIV	Human Immunodeficiency virus
HTC	HIV testing and counselling
IDIs	In-depth interviews
IDU	Injection drug users
IHBSS	Integrated HIV Behavioural and Serologic Surveillance
LGBTQ	Lesbian, gay, bisexual, transgender & queer
LGU	Local government unit
LM-GM	Learning mechanic – game mechanic
MAU	Monthly active user
MSM	Males who have sex with males
NRL	National Reference Laboratory
OFW	Overseas foreign worker
PCHRD	Philippines Council for Health Research Development
PCR	Polymerase chain reaction
PD	Participatory design
PDOH	Philippines Department of Health
PLHIV	People living with HIV
PNAC	Philippines National AIDs Council
RCT	Randomised control trial
RDT	Rapid diagnostic test
rHIVda	Rapid HIV Diagnostic Algorithm
RITM	Research Institute of Tropical Medicine
RPG	Role playing game
SACCL	STI/AIDS Cooperative Central Laboratory
SEA	South-east Asia
SOGIE	Sexual orientation or gender identity and expression
TB	Tuberculosis
TGW	Transgender women
U=U	Undetectable equals untransmittable
UNAIDS	The Joint United Nations Programme on HIV and AIDs
WHO	World Health Organization
YKP	Young key populations

Chapter 1: Introduction

This chapter begins with a description of the Philippines HIV epidemic and the public health response. The aims and objectives of the study and a description of the intervention is then provided. Section 1.5 presents a situation analysis of the four HIV testing and counselling study clinics. Lastly, my contribution to the project and positionality is outlined.

1.1 Background

1.1.1 A Brief Introduction to the Philippines

The Philippines is an archipelago that comprises 7,641 islands, approximately 1000 of which are populated (Figure 1-1). Despite its fragmented geography the Philippines identifies as a united nation with a single people, the Filipinos. Filipinos are often perceived as a unified population: characterised by their pleasing nature, adversity to disagreement and pervasive family values, but under the surface is a diverse population heavily influenced by economic and religious drivers [1].

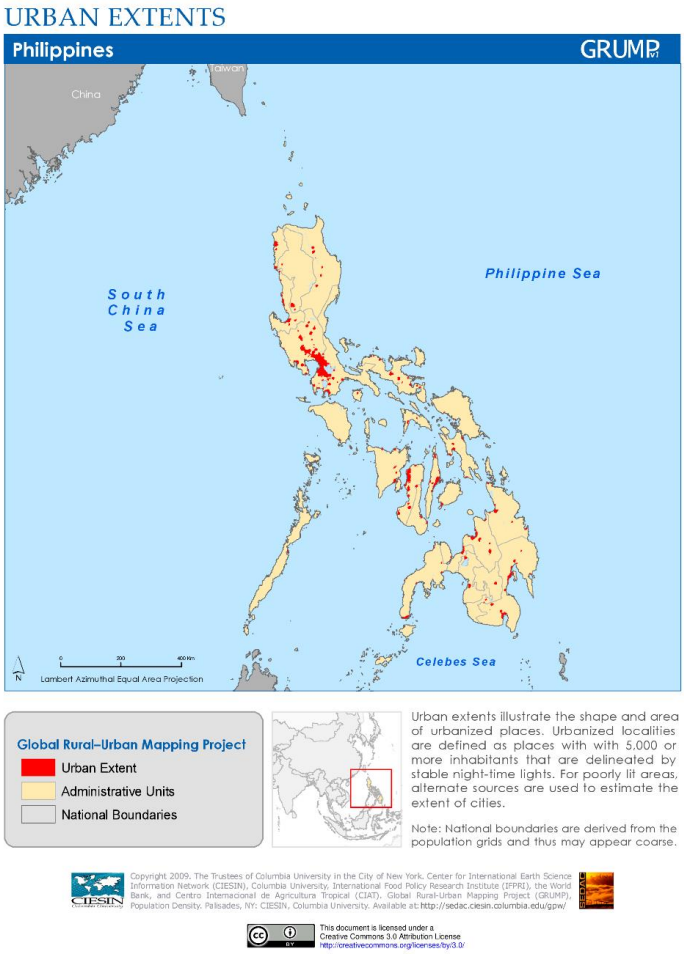


Figure 1-1: Map of the Philippines with urban extent

In 1946 the Philippines became politically independent after 350 years of Spanish colonisation and US occupation. Over the proceeding decades, the Filipino population suffered political instability and a series of failed economic strategies. Industries failed to absorb the rapidly expanding labour force, leading to increased migration from rural to urban areas and a consequential rise in urban unemployment. The 1970s marked a turning point in the Philippines economy, which saw a vast increase in Government driven labour out-migration in a bid to address internal tensions and tap into global employment opportunities [2]. Today, labour is marked as the country's greatest export with overseas remittances forming a primary means of survival for many Filipino families [3]. The sustained in-flow of remittance is one of the factors driving poverty reduction. The World Bank has estimated that the poverty rate[2] will decline from 27% in 2015 to 21.7% by 2019, provided the Philippines continues to experience economic growth[3]. Rates of unemployment are also in decline with substantial job creation in the industry sector as a leading factor; however, rates of underemployment indicate there is a significant lack of quality jobs in the Philippines and therefore pervasive labour out-migration is likely to continue [4].

The Philippines is a majority Roman Catholic country. While constitutionally separate, the state is heavily influenced by Catholic morality; same sex marriage, divorce, sex work and abortion are all illegal [5]. Individuals that practice sex outside of marriage or engage in same-sex behaviour are positioned as sinful; from the outset the Philippines is perceived to have a culture of sexual conservatism [6]. Yet the Philippines is regarded as an accepting and safe place for lesbian, gay, bisexual, transgender and queer (LGBTQ) populations[4]. The country ranked 10th most gay-friendly in a 2013 global survey covering 39 countries [7]. Non-commercial same-sex behaviour has never been criminalised and pride has been celebrated openly since the mid-1990s. However, members of sexual minorities still face discrimination and social marginalisation [8]. Local anti-discrimination ordinances, banning discrimination based on sexual orientation or gender identity and expression (SOGIE) are in place in 19 local government units [9]. While a SOGIE equality bill was passed by the lower House in September 2017, it continues to face stiff opposition from religious and conservative groups in the senate (Figure 1-2). The lack of national policy risks leaving sectors of the LGBTQ population with no recourse for redress in the face of discriminatory practices.

[2] Based on the lower middle-income poverty line of US$3.20/day.

[3] Growth is now projected to significantly decelerate from 2020 due to the impact of the COVID-19 outbreak in the Philippines.

[4] In 2015 the estimated population size of MSM was reported as 531,500 or 2.2% (1.8%-3.2%) of males aged 15-49 [24]. The estimate was further divided into transgender woman (23% of MSM population) and male sex workers (16% of the MSM population).

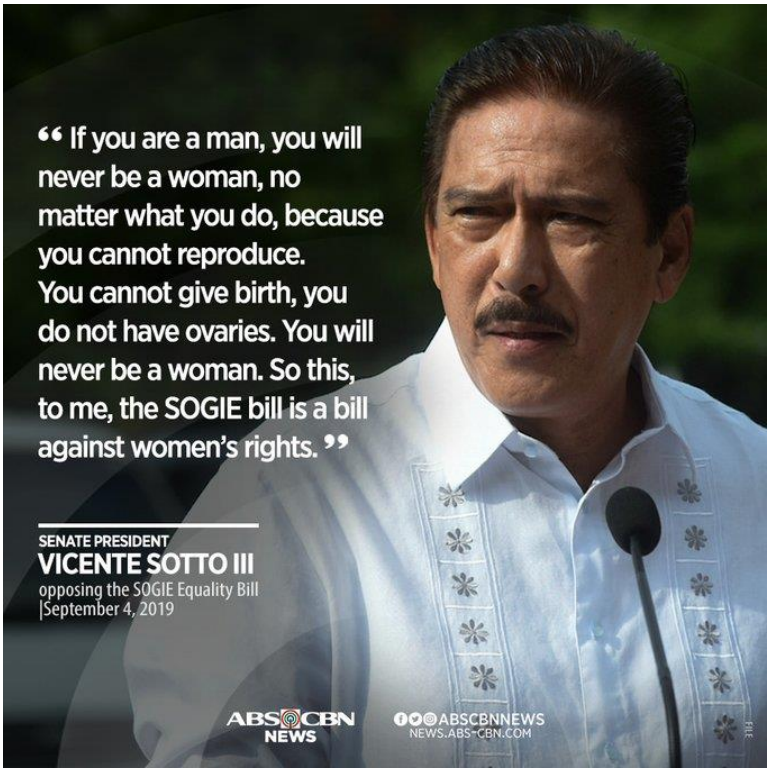


Figure 1-2: SOGIE bill opposition-source @ABSCBNNews

In contrast to the momentum towards inclusive human rights, the national government has come under strong critique for its brutal ‘war on drugs.’ According to the Philippines drug enforcement agency the death toll for the national ‘war on drugs’ stands at 5,050. The Philippines commission on human rights estimates it is closer to 27,000 as a result of extra judicial killings by so called ‘death squads’ and the police withholding records [10].

1.1.2 An Epidemic Emerges

During the second decade of the global AIDs crisis, as countries across Southeast Asia experienced rapidly emerging HIV epidemics, the Philippines appeared to have a unique level of immunity. From 1984 when the first HIV case was detected to 2010 the country maintained a low prevalence rate of less than 0.1% among the adult population, and between <1% to 2% among high-risk populations which included; overseas foreign workers (OFW), female sex workers (FSW), men who have sex with men (MSM)[5] and injection drug users (IDUs) [11–13]. In a review in 2010, the authors reported prevalence below 0.1% ‘even in populations at high-risk,’ a spurious statement that fails to define high-risk and is in conflict with previously reported prevalence rates among OFW, FSW, MSM and IDUs [14].

[5] Prevalence rates for transgenders in the Philippines is not reported in the literature between 1984 – 2010, related literature indicates that transgender women were either categorised as MSM or FSW.

Experts were left baffled as to why the Philippines seemed to be protected from the HIV epidemic. The literature prior to 2010 did not provide empirical evidence for any geographical, behavioural, or biological causes of this 'low and slow' epidemic.

When experts reasoned the countries geographical isolation from mainland Asia was a factor it was refuted [12,14], in part because of the known high numbers of overseas workers [15] and evidence of poor knowledge, attitude and practices of sexual health among Filipino seamen [16]. Yet studies still showed surprising results for the prevalence of HIV among OFW. Analysis of blood screening data reported to the STD/AIDS Cooperative Central Laboratory (SACCL) between 2002 and 2004 detected only 1 HIV case out of 69,123 OFW (0.001%); however, within the discussion the authors note sampling bias, limitations in the data and state further evidence is required to understand the factors that had so far left the Philippines unscathed by the HIV epidemic [17].

When sexual conservatism among Filipinos was presented as a potential factor, any behavioural data backing the claim was either limited or non-existent [14]. National behavioural surveillance studies also presented evidence of high rates of sexually transmitted infections (STI), low condom use, increased practices of anal sex and Filipinos becoming sexually active at a young age [12].

Given HIV initially spread among IDU in neighbouring Asian countries, the Philippines was predicted to follow a similar trend [18]. A study on the prevalence of hepatitis C virus (HCV) among IDU was conducted as a surrogate marker for early detection and prevention of HIV in the Philippines. Results from the 6-year chronological study corroborated reports that while HCV was endemic among IDU, HIV was not. Despite this, the authors expressed a need for 'careful observation' of HIV/HCV coinfection among IDU [13].

The low rates of HIV incidence prior to 2010 was attributed by some to the passive case surveillance system and a known reluctance among the population to access health services [19]. From 1987 to 1993, the Philippines Department of Health (PDOH) HIV/AIDS Registry (HARP) was the only method used to monitor trends in HIV [20]. To address this limitation the PDOH established the national HIV surveillance survey in 1993 and integrated a behavioural survey in 1997. The cross-sectional studies, targeted at key populations (FSW, MSM and IDUs), are conducted every 3 years and continue to this day. Since 2007, the study methods have remained relatively unchanged and follow WHO/ UNAIDS HIV surveillance guidelines. Studies include a face-to-face behavioural survey, collection of blood specimens, and laboratory testing for HIV and syphilis, as well as testing for HCV in IDUs. Given the hard-to-reach nature of the target populations, the Integrated HIV Behavioural and Serologic Surveillance (IHBSS) employs time location sampling for MSM and FSW and respondent driven sampling for IDUs. While both sampling methods are recommended for populations encumbered by social stigma, the current climate around illegal drug use in the Philippines,

combined with the decline of venue-based socialising, will undoubtedly raise challenges and could leave certain sub groups within these key populations hidden.

There was a recurring warning present in all the studies noted above; the Philippines contained all the ingredients for an explosive HIV epidemic in the absence of vital healthcare services and accurate surveillance systems. Findings of increased HIV prevalence and risky behaviours through the introduction of prospective surveillance of HIV among at-risk populations wasn't enough to motivate political leaders to take effective preventative action and the Philippines was unable to maintain its unique stance. From 2010 to 2016 HIV infection rates increased by 140% (10,500 HIV cases were reported in 2016 - up from 4,300 in 2010) [21]. The 2015 IHBSS reported prevalence among at-risk populations at 4.9% for MSM, 29% for IDUs and 1.7% for male to female transgenders. The IHBSS failed in its purpose as an early warning system for HIV. A government that was once praised for curbing the spread of HIV now faces criticism for a low and slow response to what is being reported as the fastest growing HIV epidemics in the region.

1.1.3 A Shift in Risk

Between 2007 to 2011 there was a significant shift in the predominant mode of HIV transmission from male-to-female to male-to-male sexual contact, which coincided with a sharp rise in the transmission rate [22]. Early reports of HIV infection in the Philippines were concentrated among FSW who served clients from the US military [23]; leading to assumptions that Western strains were the first locally transmitted in the country. It is argued that the shift in key populations occurred because of enacted policies and interventions targeted at sex workers; while this successfully curbed transmission among FSW, heterosexuals and the general population, the MSM and TGW populations were neglected [24]. In addition to this, prospective surveillance of HIV focused on OFW as a bridging population and positioned HIV as an imported rather than indigenous disease. A small-scale cohort study in Manila and Cebu conducted two rounds of genotypic analysis on 163 blood samples from HIV seropositive patients, between 2008 and 2012. Results were grouped into MSM & visa applicants (n=32), MSM (n=31), sex workers (n=6), IDU (n=68) and visa applicants (n=26). The study identified substantial overlap of HIV subtype CRF01_AE between MSM and visa applicants. In contrast, the MSM and IDU samples harboured different major HIV subtypes [25]. Due to the small sample size and geographical reach the study did little to explain the transmission dynamics within the MSM population and drew focus away from social determinants of HIV risk which may have better explained the emergence and sharp increase in HIV cases among MSM.

The concentrated epidemic among MSM in the Philippines is showing no signs of waning. Fuelling the epidemic are consistent findings of low condom use and widespread misconceptions around HIV/AIDS [26]. Review of epidemiological data also found a

decreasing trend in the average age of diagnosis [14]. While this may be indicative of increased testing rates it may also be a consequence of a decrease in age of infection.

Young key populations

The proportion of HIV positive cases in the 15-24-year age group increased from 25% in 2006-2010 to 29% in 2011-2018. From January 1984 to June 2018, 15,834 (28%) of the reported cases were 15-24 years old; 96% (15,272) were infected through sexual contact (1,778 male-female sex, 8,886 male-male sex, 4,608 sex with both males & females), 467 were infected through needle sharing among IDUs, one was infected through mother-to-child transmission [27]. Reports demonstrate a worrying trend in horizontal transmission among young key populations. Similar trends are also reported by the HIV/AIDS registry within the 10-19-year age group, with a majority of infections through sexual contact.

In a recent study by the Philippines National AIDS Council (PNAC), the average sexual debut among Filipinos pegged at 16-17 years-old with a lag of 2 to 3 years before first condom use, indicating high risk of sexual transmission during early sexual experiences.

There is still a way to go to understand the true scale of the concentrated epidemic among young MSM in the Philippines. Current surveillance systems for HIV may result in underreporting of cases among young key populations. Time location sampling used in the IHBSS does not account for the increasing trend of young MSM and TGW using mobile applications and social media to arrange gatherings at private locations. Access to HIV testing and treatment facilities is restricted among 15-24-year olds with additional legal constraints for those under 18[6]. While limited, available evidence demonstrates a need to act fast and develop tailored interventions targeted at adolescent and young adult key populations to turn the tide on the Philippines HIV epidemic.

The present epidemic among IDUs should not be dismissed; however, the current political climate poses significant risk to research involving this population. This in turn restricts our ability to design appropriate interventions for this group and is a key reason for giving focus to MSM and TGW at the exclusion of this group. For the purpose of protecting vulnerable individuals' participants drug use was not explored during the study.

[6] Parental consent is required for anyone under 18 to undergo a HIV test – in 2018 local government units in Davao Region started the process of reforming policy to allow social workers and health professionals to give consent for individuals under 18.

1.2 Public Health Response

Box 1.2 Philippines Decentralised Health System

Local Government Code of 1991 was enacted for the devolution of health care systems from the national government to local government units (LGUs); enabling LGUs to prioritise health services to meet the needs of the local population. Hence the operation and maintenance of local health facilities was transferred from the PDOH to the province governor or mayors of municipalities and cities. This also includes the provision of HIV testing, counselling and treatment services in accordance with national guidelines.

Legal Framework for HIV Prevention & Control

A 20-year-old statute known as the Philippine AIDS Prevention and Control Act of 1998 (Republic Act No. 8504) acts as the country's legal framework for the prevention and control of HIV. As part of the act the Philippines National AIDS Council (PNAC) was reconstituted to be the central advisory, planning and policy-making body. PNAC is the coordinating partner of the National HIV/AIDS and STI Prevention and Control Program (NASPCP). The body is currently on its 6th iteration of a national HIV plan formally known as the AIDS Medium-Term Plan 2017-2022 (AMTP); providing recommendations for programme design, policies and strategies for HIV prevention and control among at-risk groups. Complimenting the AMTP is the Philippines' Health Sector Plan: HIV Prevention and Control Operational Plan 2018 – 2020 which outlines a series of costed initiatives to strengthen the HIV response and provides additional guidelines on the provision of HIV services for young key populations. While the plans put forward evidence-based initiatives, tailored to the needs of at-risk groups, they also note numerous implementation challenges resulting from a conflicting and non-responsive policy environment, funding gaps and poor communication of guidelines to local actors. This counterproductive environment is laid bare upon description of the country's recent adoption of rapid point of care diagnostics for HIV.

Location-based Health Disparities: HIV Testing & Prevention

Testing for HIV in the Philippines first became available in 1985 and evolved into the voluntary and confidential testing and counselling (VCT) practice in use today [28]. During the study period the national HIV diagnostic algorithm underwent substantial reform. In 2016, the NASPCP introduced a rapid HIV diagnostic algorithm (rHIVda); aligned with WHO recommendations and expected to reduce turnaround time for results from 7-21 days to 30-60 minutes. Between 2016-2017 rHIVda was piloted and validated in 8 government and non-government VCT clinics in the National Capital Region and Davao Region. During the validation study, pilot sites were instructed to run rHIVda in parallel with the current algorithm (Figure 1-3). Poor communication of implementation guidelines, conflicting laws and supply

chain issues generated varying interpretations of rHIVda at the pilot sites. For example, testimony from clinic staff at sites in the National Capital Region revealed that positive results were frequently released to clients if they were reactive to just 2 of the rHIVda tests. This was primarily due to frequent stock outs of the Vidas HIV Duo Ultra test kit. In addition to this, the PhilHealth Outpatient HIV/AIDS Treatment Package, which covers clinic costs for HIV treatment and laboratory tests and is paid through a case-based payment scheme, required confirmatory results from SACCL for a claim to be approved. This generated variations at the rHIVda pilot sites as to when reactive clients could enroll on to treatment with clients referred elsewhere for treatment typically at a disadvantage.

An administrative order providing implementation policies and guidelines for national roll out of rHIVda was issued in 2019. Public clinical laboratories can now apply to become certified rHIVda confirmatory laboratories and PhilHealth now legally recognises confirmatory test results based on rHIVda. Assessment on whether the clinical laboratory meets the eligibility criteria for certification will be conducted by SACCL.

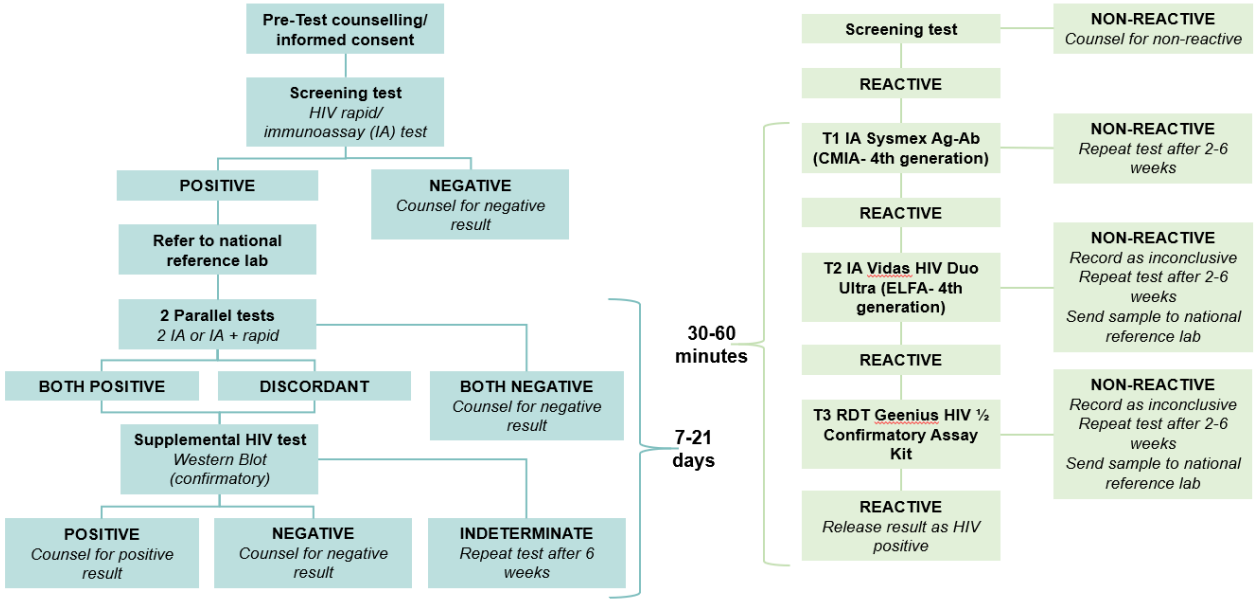


Figure 1-3: Left - old national HIV diagnostic algorithm, right - rHIVda

Current funding gaps threaten widespread adoption of rHIVda. As of 2019, the Disease Prevention and Control Bureau had not released a budget for the implementation of rHIVda guidelines and it is unclear whether LGUs will be able to provide the necessary financial support from their already restrictive budgets. As it stands, access to rapid HIV diagnostics is dependent on the client's location.

While national policy states that non-stigmatizing VCT services for MSM and TGW must be available, the Philippines' decentralised health system (Box 1.2) has led to geographic disparities in the quality and availability of HIV testing services [29]. On one end of the scale are the innovative HIV prevention initiatives enacted by Quezon City Council. Quezon City

maintains three sundown clinics (Klinikas) that provide rapid HIV testing, counselling and treatment services outside 9 to 5 working hours in a non-stigmatizing environment for MSM and TGW. These sundown clinics are also certified rHIVda confirmatory laboratories. The city has also increased funding for its HIV programme 9 times since 2012. The Quezon City HIV programme is widely praised by government officials and is seen as a desirable model for other cities to follow. However, the ability of local governments to sustain HIV services to this standard is compounded by their reliance on external funding sources and insufficient budgetary commitments from the national government [30].

The most recent HIV prevention initiative to reach the Philippines is the use of pre-exposure prophylaxis (PrEP) for at-risk groups. A validation study for PrEP began in 2017. It's expected roll out of PrEP will face similar challenges to those found in the implementation of rHIVda as well as resistance from conservative groups. As of 2020, PrEP is only available at selected non-government VCTs in the National Capital Region [31].

Use of MSM and TGW peer counsellors in government and non-government VCT clinics has been widely adopted in the Philippines and is a mainstay in the comprehensive package of HIV services for MSM and TGW outlined in the AMTP.

Shortage Scares: HIV Treatment

There is a total of 82 PDOH designated HIV treatment hubs and primary care facilities across 15 regions which provide in-patient and out-patient HIV treatment services including but not limited to free ARV therapy, clinical management, patient monitoring and psychosocial support services. ARV medication is procured annually by the Disease Prevention and Control Bureau based on forecasts by NASPCP. During the study period rumors circulated on social media of ARV shortages which prompted the PDOH to release an official statement in 2019 to reassure PLHIV that "great steps had been taken to guarantee the availability of ARV medication [32]." In the statement they thanked the Global Fund for their continued support to fill gaps in the treatment programme; further evidence of the government's reliance on external funding sources.

In 2018 the Philippines officially adopted the test and treat strategy after consultation with health providers at VCT clinics [33]. Prior to this, national guidelines stated that PLHIV should be initiated on to treatment once their CD4 count dropped below 500.

Conservative Constraints: Access to Sexual Health Services

Existing laws and policies impose restrictions on adolescents to access sexual health services [34]. Those of particular relevance to HIV prevention and control include; the requirement of parental and spousal consent for those under 18 to purchase condoms and undergo HIV and STI testing, and advice which gives substantial power to religious and conservative interest groups in the delivery of sexual health services and education.

Reported use of condoms is very low [35]. Reasons given for not using a condom are a lack of availability, concerns that condoms often fail or inhibit pleasure and the stigmatized process of purchasing condoms [35,36]. The Responsible Parenthood and Reproductive Health Act of 2012 (Republic Act No. 10354, known as the RH Law) prohibits condom purchases by individuals under the age of 18 without parental consent. As a result, retail store employees routinely refuse to sell condoms to youths or demand that they provide identification, which is likely to be off-putting, especially for young MSM and TGW. The only place governments provide free condoms and lubricants is at social hygiene clinics but that is not always guaranteed. In 2016, the government was powerless to stop the mayors of Balanga City in Bataan province, and Sorsogon City in the Bicol region, issuing directives to government clinics forbidding them from procuring and distributing contraceptive products [36].

Condoms are a flashpoint for controversy in the Philippines. Since the early 1990s, the Catholic Bishops Conference of the Philippines has publicly vilified condoms, campaigned and raised legal battles against legislation that would increase access to contraceptives and even levied personal attacks and death threats against government officials [37]. To this day the Catholic Bishops Conference of the Philippines remains strongly opposed to the promotion and use of condoms in the national HIV response, and in 2017, successfully stopped a PDOH initiative to distribute free condoms in public high schools [38]. Even the executive branch shows little support for condom use. In 2018 during a televised address to returning overseas workers (mostly women), President Rodrigo Duterte urged the audience not to use condoms because they ‘aren’t pleasurable’ and demonstrated his point by proceeding to eat a candy with the wrapper on (Figure 1-4). In a bid to reduce the restrictive influence Catholic and conservative values hold over the accessibility of condoms, the PDOH is currently pushing for condoms to be reclassified as an infection prevention commodity, not as a family planning commodity.

Figure 1-4: Human Rights twitter statement on President Duterte's condom criticism

Influence of religious groups can also be seen in the cautious and failed approaches to introduce internationally recognized and comprehensive sexual health education in schools. 2018 marked a new strategy towards addressing the distinct lack of quality government led sexual health education for young Filipinos. An administrative order by the Philippines' Department of Education, to integrate 'age-appropriate and culture-sensitive' sex education in the basic elementary and high school curriculum, was approved after years of campaigning by advocacy groups. Based on the order, the comprehensive sexuality education will have seven core topics: human body and human development; personhood, healthy relationships; sexuality and sexual behaviours; sexual and reproductive health; personal safety; and gender, culture and human rights. History is expected to repeat itself with pro-life groups enacting legal challenges against the order which has in the past been successful in stopping HIV prevention initiatives in schools.

1.3 Aim and Objectives

Assessment of the situation in the Philippines demonstrates a clear need for interventions targeted at young MSM and TGW which align with current efforts to curb the surge in HIV cases. Emerging technologies for health promotion present an exciting opportunity but greater understanding is required to support the design and evaluation of such interventions in the Philippines context.

Study Aim

To explore the contribution and limitations of a tailored digital game for health aimed at improving HIV-related knowledge, attitudes and practices among young key populations in the Philippines.

Objectives

1. To identify appropriate learning objectives and theoretically driven game design relating to HIV prevention and control among young key populations in the Philippines.
2. To develop a playable and acceptable behaviour change game targeted at young key populations in the Philippines.
3. To assess demand and reach of the game among target users.
4. To explore the effect of the game on cognitive and social determinants of HIV service use and behaviour.

1.4 Description of the Intervention: Games for Health

A game is a creative expression of art and interactive entertainment where players engage in activities defined by rules, and make decisions in order to achieve a goal or produce an unforeseeable outcome [39]. There is a wide variety of use for digital games that expand beyond pure entertainment, most come under the umbrella term of serious games; however, games specifically designed to influence knowledge and behaviour for personal and public health benefit are typically classified as games for health.

Games for health covers a diverse range of interventions: there are exergames, where the player interacts with the game world through physical movement to improve fitness and mental wellbeing [40]; there are simulation games, targeted at health professionals, to support training in specific procedures or to improve decision making within complex systems [41] and there are virtual reality games used in pain management [42].

The heterogeneity within the games for health category highlights an importance to clearly define the intervention in question. The branch of games for health relevant to this study are behaviour change games. Behaviour change games seek to influence health related knowledge and perceptions and ultimately improve health related behaviour and health outcomes. Games of this nature are often underpinned by cognitive theories of behaviour change [43].

Why Play Games?

As the HIV epidemic worsens, social changes are occurring for young people in the Philippines. Increased online connectivity, a growing economy and prevalent mobile device use has changed the way people spend their time and socialise; placing mobile games as a promising platform to improve knowledge, attitudes and practices relating to HIV prevention.

Mobile games contain structural elements that effectively engage users [44], and it is through these elements that mobile games could influence behaviour determinants. Players can model health-related behaviour and witness positive and negative outcomes within a safe environment. Well-designed narratives, integrated with the gameplay, can foster identification with the characters, thereby increasing a player's sense of personal risk or self-efficacy in overcoming barriers to HIV services [45]. Positive portrayals of characters living with HIV may help form beliefs that players can also remain or become their desired self after a positive diagnosis. Influence may also be found from the complex interplay between digital gaming and social behaviour [46]. Even a single-player mobile game can trigger meaningful social interactions, from recommending a new game to offering advice on how to complete a challenge. For example, a player may recommend the game to a peer or family member who they believe could benefit from the health-related content. Narratives and characters within the game could also trigger meaningful conversations within social groups. Such use of the game could generate social pressure around health-related behaviour.

Using the Behaviour Change Wheel developed by Michie in 2011 to support the classification of behaviour change interventions [47], the use of mobile games as described above sit within three identified functions of behaviour change interventions; persuasion (using communication to induce positive or negative feelings or stimulate action), education (increasing knowledge or understanding), and modelling (providing an example for people to aspire to or imitate). In a 2015[7] qualitative study on enablers and barriers to condom use and HIV testing among MSM and TGW by the Philippines Department of Health (PDOH) Epidemiology Bureau, they reported fear and anxiety over a positive result as a primary reason for not getting tested, along with poor knowledge of HIV and HIV services [48]. The functions of persuasion, education and modelling that can be established within mobile games provide a common-sense approach to reduce salient beliefs and knowledge gaps identified as prominent barriers in the Philippines context. [Critical review of enablers and barriers to HIV services and the implications for the game design is presented in Chapter 2]

While there appears good justification for the use of behaviour change games in the Philippines context there remains a paucity of digital game-based interventions targeting HIV risk behaviours in low- and middle income countries (LMICs) [49]. Thus, the transferability of

[7] Study conducted in 2015, findings published in 2016. The report title indicates only MSM were included in the study but this is due to categorising the TGW as MSM.

design approaches used in behaviour change games within western contexts remains under question.

Potential and limitations in the cognitive approach to behaviour change games

Evidence in support of behaviour change games underpinned by cognitive theories of behaviour change exists but is limited and reflects an industry in its infancy [43]. A prominent study in the games for health sphere is the Re-Mission trial, which evaluated a PC game designed to improve adherence to cancer treatment in adolescents and underpinned by Social Cognitive Theory [50]. The game was one of the first to validate a behaviour change game using a large-scale randomised trial and found a significant increase in treatment adherence in the intervention group using both self-report and objective measures of adherence [51]. The study is a key driving force behind the rapidly expanding field of games for health, but the mechanisms in which the game achieved its positive effect on health outcomes are still not well understood.

While existing studies, namely the Re-Mission trial, demonstrate the potential of behaviour change games in improving health related behaviour, further literature and understanding of LMIC context suggest the effect of such interventions could be limited if they remain solely focused on the individual level without consideration into the wider health system and policy environment. Within LMIC contexts, restricted access to quality HIV testing and treatment services may present a more significant barrier to HIV diagnosis and treatment [52]; therefore, while the game may be successful in positively influencing cognitive mediators of HIV service uptake this may not translate to actual behaviour in the context of weak health systems. Selection of underpinning theory to guide the game design will be a crucial decision and there is a need to look beyond the commonly applied theories within the games for health literature to ensure both individual and environmental variables of behaviour are considered [see section 3.3.1].

Design and development approach

Games for health design and evaluation requires a cross-disciplinary approach involving target users and experts in game design, social sciences, the subject-domain and the context in which the game will be deployed. Effective and appropriate methods of engaging these different actors is not well understood, especially in non-western contexts. This study represents the first attempt to design and launch a game for health through a user-centred design approach in collaboration with local academic and government partners in the Philippines. Figure 1-5 summarises the timelines of the design and development process and shows the iterative steps of involving users and working with developers to refine the game (in green).

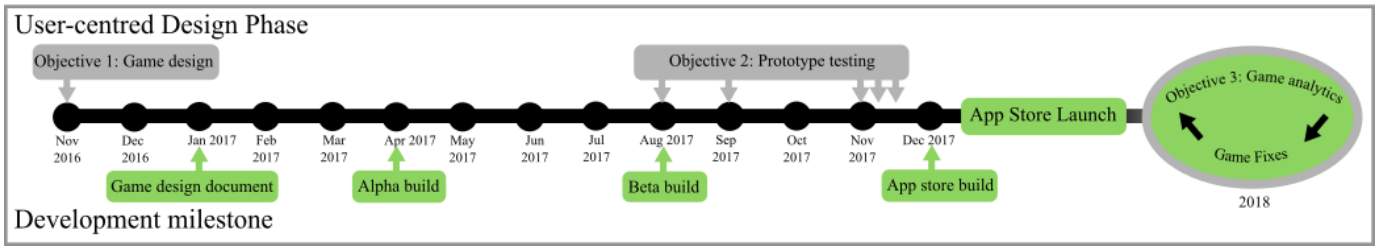


Figure 1-5: User-centred game development process

1.5 Methodological Approach: Rationale

On the surface, behaviour change games appear to be a promising new approach to increase uptake of HIV services among young key populations in the Philippines. The common-sense approach of using games to persuade, educate and inspire appears fitting given the parallels between these functions and standard game elements. There is also empirical evidence to show such games can be effective in improving health related behaviour. However, this study represents the first attempt at designing and implementing a game for health in the Philippines' context. As such it provides an opportunity to generate lessons on what worked, what didn't, for who and why, through close observation and reflection. A purely positivist approach may have the benefit of providing time- and context-free generalisations, but this was not desirable, as the context and potential game effect are intertwined. I therefore proceeded with a mixed methods approach to enable me to use a rich set of data to inductively generate explanations. In an article by Johnson and Onwuegbuzie, the authors provide a pragmatic approach to mixed methods research stating 'mixed methods research should…use a method and philosophy that attempt to fit together the insights provided by qualitative and quantitative research into a workable solution' [53]. Within this study emphasis was placed on qualitative research. Qualitative analysis was supplemented with quantitative data to corroborate and strengthen findings.

1.6 Description of Study Sites

Qualitative and quantitative data relating to objective 1, 2 and 4 were collected in the National Capital Region (NCR) in the Cities of Manila, Quezon, Mandaluyong, Makati and Taguig, and in Davao Region (Southern Mindanao) in the Poblacion District (Figure 1-6). All FGDs and interviews we're conducted in person with local participants.

For objective 3, data were collected from devices with the game installed and where the user granted permission for the game to collect and send data. The game was freely available to download from the Google Play and App Store worldwide. Geographic coordinates gathered through the Unity Analytics service enabled researchers to analyse the data at national, regional, city and district level.

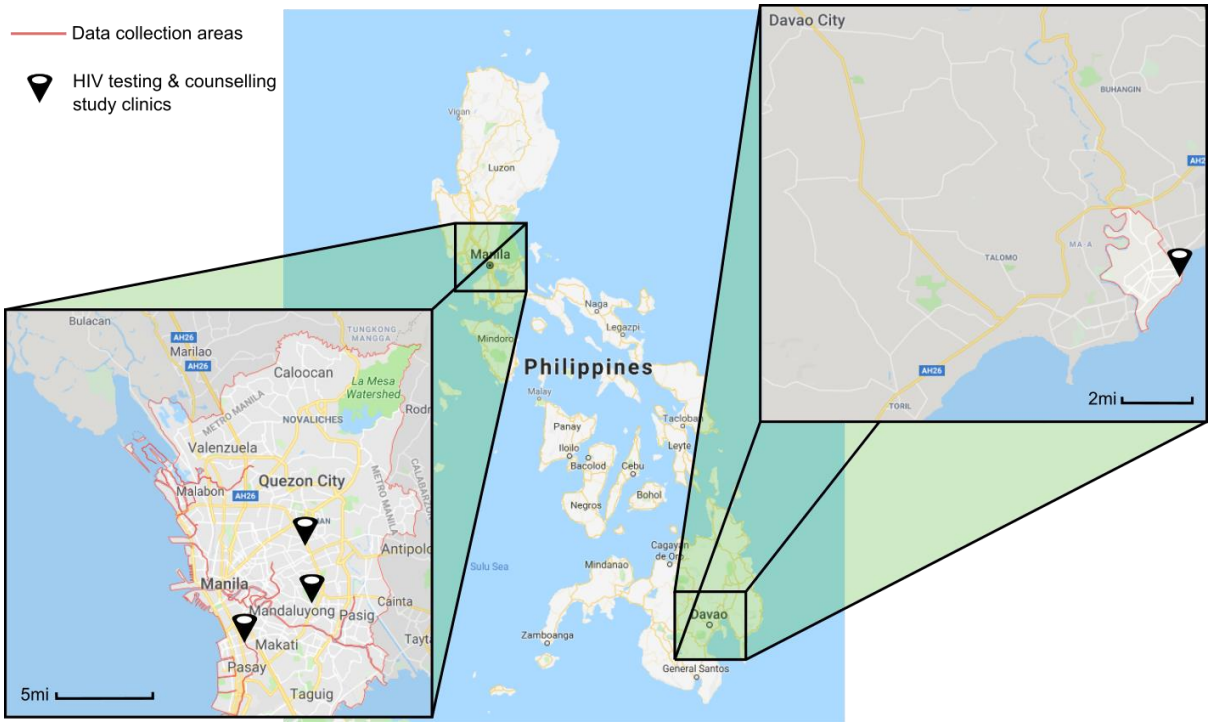


Figure 1-6: Map of study sites

The NCR is composed of 16 cities and encompasses an area of 239.22-square-miles with a population of over 12 million [54]. It is located in the Southwestern portion of Luzon. It is the most densely populated region and represents the central economic powerhouse of the Philippines. From January 1984 to March 2018, 41% (21,641) of HIV cases we're reported from the NCR [55]. While the availability of HIV testing and treatment services is substantially better compared to other urbanized and rural areas in the Philippines, health facilities in the NCR are overburdened and under resourced, often leading to long waiting times and client drop out [31]. During the study, the NCR was reported to have 23 HIV treatment hubs and primary health facilities[8], overseeing the care of around 23,000 people living with HIV (PLHIV) [55].

The centre of Davao Region is the City of Davao. The city is the largest in the Philippines in terms of land area, covering an area of 943.48-square-miles with a population of over 1 million [56]. In March 2018, Davao Region was reported to have four HIV treatment hubs and primary health facilities, overseeing the care of around 3,000 PLHIV [55]. Davao Region, also known as Region 11, is one of the top six regions with the greatest number of newly diagnosed HIV cases; from January 1984 to March 2018, 6% (3,065) of HIV cases we're reported from this region.

[8] Total number of HIV treatment hubs and health facilities was calculated using the September 2018 HARP and cross referencing with the clinics website to ensure they were operational during the study period, October 2016 to October 2018.

1.6.1 HIV Testing and Counselling Clinic Mapping

Data were collected from four HIV testing and counselling (HTC) clinics, three in the NCR, one in Davao Region (Figure 1-6). Clinics were selected based on the following criteria:

1. followed rHIVda (Figure 1-3), developed by SACCL and the HIV National Reference Laboratory (NRL) with support from NRL Australia and WHO and implemented by the PDOH;
2. provided pre- and post-test counselling in accordance with national guidelines [57];
3. provided free HIV diagnostic services;
4. promoted young adult and adolescent MSM and TGW friendly services, through targeted advertisements and use of young MSM/ TGW counsellors;
5. formally agreed to support all data collection activities throughout the study through a memorandum of understanding.

Clinic visits for the three sites in the NCR were conducted in November 2016 to map the HTC workflow, available services and condition of the facilities. Davao Reproductive Health and Wellness Centre (DRHWC) was mapped in January 2017. A summary of the clinic mapping is presented in Table 1. Regular contact with all four clinics was maintained throughout the study to ensure any confounding factors that were likely to impact HTC use were recorded.

Table 1: Summary of clinic mapping activity

	Klinika Bernardo	Loveyourself Uni	Loveyourself Anglo	DRHWC
General Description	Klinika Bernardo is a free HIV diagnostic, treatment and referral facility. The clinic is situated behind the Ramon Magsaysay High School building along EDSA, Cubao, Quezon City. It was created through a Quezon City Government ordinance in January 2014 and is directly supervised and managed by the local government health division. The building houses 2 clinics, 8am to 3pm it is a HIV testing and treatment hub for FSW, 3pm to 11pm the same services are offered for MSM & TGW. The clinic is the treatment hub for Quezon city, so clients diagnosed at other sites in Quezon City can be referred here for treatment.	LoveYourself Uni is a free HIV diagnostic and referral facility situated along San Marcelino Street in Malate. It is targeted specifically at young MSM & TGW. The clinic opened in February 2016. As well as testing services it also acts as a community education centre for sexual health. Hence the name Uni as in University. The clinic works in partnership and is funded by Research Institute for Tropical Medicine (RITM) and several private sector sponsors. Reactive clients are referred to either RITM or LoveYourself Anglo for baseline tests and treatment.	LoveYourself Anglo is a free HIV diagnostic, treatment and referral facility situated on the 3rd floor of an office block on Shaw Boulevard, Mandaluyong City. It was the second clinic opened by the LoveYourself Organisation in June 2014. It is targeted specifically at young MSM & TGW. The clinic works in partnership and is funded by RITM and several private sector sponsors.	DRHWC is a free HIV diagnostic, treatment and referral facility. It became a treatment hub in February 2016 and aims to become a one-stop-shop for HIV services. Throughout the study the clinic was housed in temporary accommodation in Ramon Magsaysay Park, off Quezon Boulevard, while major renovations were taking place in the original building. The clinic re-opened in the new building January 2019. The clinic is funded by the Davao City Health Office and the PDOH Regional Office. The clinic works in partnership with the Alliance Against AIDS in Mindanao.
Opening times	Mon – Fri: 3pm to 11pm Closed on weekends. Community-based screening with counsellors and medical technician 11pm onwards. Cut off for testing registration is 9pm as lab tests for positive clients are run from 9pm to 10pm. Clients availing for testing after 9pm are told to return another day.	Wed – Sat: 12pm to 7pm Sun: 9am to 2pm Conduct community-based screening but this is not scheduled on a regular basis. No cut off time for testing registration but after a certain time some clients will have to return next day for their results depending on how busy the clinic is that day.	Wed – Sat: 12pm to 7pm Sun: 9am to 2pm Conduct community-based screening but this is not scheduled on a regular basis. No cut off time for testing registration but after a certain time some clients will have to return next day for their results depending on how busy the clinic is that day.	Mon – Fri: 9am to 3pm 3rd and 4th Fri of the month: 7pm to 10pm Conduct community-based screening but this is not scheduled on a regular basis. No cut off time for testing registration but after a certain time some clients will have to return next day for their results depending on how busy the clinic is that day.
Avg. client intake for HIV testing services	Avg. 392 clients per month*	Avg. 874 clients per month	Avg. 1108 clients per month	Avg. 339 clients per month

Facilities	**Interior** Professionally decorated using a green and white colour scheme. Large murals and motivational posters cover the walls. 4 counselling rooms with comfy chairs, artwork and lamps offering a soundproof private space. Aircon & fans in all rooms. Spacious waiting area with lots of seating available. Comfortably seat up to 20. Large flat screen TV for entertainment. Clinic situated on second floor. Black-out curtains cover the windows, no way to see clients inside from street. Facilities are very clean. There is some damage to the plastering on the ceiling that they are working to get fixed. Some clutter and old furniture in the hallways. **Road access/ signage** Clinic situated on a dimly lit alleyway off a major highway. Tall security gates in front of the property. A large painted banner for the clinic covers the wall next to the gate. The building has illuminated signs with the clinic name over the door. No signage at the road entrance.	**Interior** Urban modern décor in waiting area, large benches covered in artificial grass. Large TV in corner. Comfortably seat up to 20. Magazines and motivational books in waiting area. Free condoms and lube available. 4 private counselling rooms, each with a sterile clinic décor contrasting with the style of the waiting room. Aircon in all rooms. 1 conference room seating 15-20 used for group sessions & staff meetings. Clinic situated on second floor of building. No windows in waiting area. All windows in building are covered with blinds. Facilities are very clean. **Road access/ signage** Clinic situated on a busy highway. Small Loveyourself sign on second floor of building. Limited parking available outside clinic, 1-2 spaces. Good public transport links as situated next to Buendia Train Station and on a popular Jeepney route.	**Interior** Homely décor with large sofas, coffee tables and TV in waiting area. The waiting area is split into 2 rooms, the first is where you register for testing which has seating for around 10 people. The next room is where you wait after pre-counselling before going for blood extraction and test results and can comfortably seat up to 10. There is some clutter. Aircon in all rooms. Free condoms and lube available. 7 private counselling rooms. Facilities are clean. **Road access/ signage** Clinic is situated on the 3rd floor off a busy highway. There is limited parking outside, 1-2 spaces. There is a small Loveyourself sign raised above the sidewalk. Posters/ signage outside the door on the 3rd floor. Public transport links can be accessed close to the clinic.	**Interior (temporary residence)** Interior is dated and cluttered. No defined waiting area, clients tend to sit on the plastic chairs near the reception desk or on the wooden benches immediately outside the clinic. Limited aircon and lots of fans providing a comfortable temperature. 6 makeshift counselling rooms using plywood and curtains furnished with plastic chairs and posters. Not soundproof. Facilities were not adequately clean and there were clear signs of rodent infestation. **Road access/ signage** Clinic situated on the ground floor on a row of health centres. Building within the grounds of a public park, just outside the clinic is a dilapidated children's play area. Plenty of available parking space. Available public transport as park is on a popular Jeepney route.
Services	• Community-based screening • Pre + post counselling • rHIVda testing procedure • CD4 count • Hepatitis B test • Complete blood count (CBC) • Urinalysis • Referral for chest x-ray • ARV treatment programme after 5 baseline tests completed • Check-ups for PLHIV • On occasion provides ARVs to other satellite clinics in Quezon City	• Community-based screening • Pre + post counselling • rHIVda testing procedure (regular stock shortages of 1 out of 3 RDT kits) • Referral to Loveyourself Anglo or RITM for baseline labs & treatment • Community health education	• Community-based screening • Pre + post counselling • rHIVda testing procedure (regular stock shortages of 1 out of 3 RDT kits) • Hepatitis B + Syphilis testing • CD4 count • CBC • Referral to RITM for baseline tests & treatment if more appropriate for client • ARV treatment programme after baseline tests complete • Life coaches for PLHIV • Community health education	• Community-based screening • Pre + post counselling • rHIVda testing procedure • Referral for baseline tests at 3 external sites • ARV treatment programme after baseline tests complete

Testing Procedure (registration to access to treatment)	1. Client completes paper-based patient record form 2. Clinic staff encode and verify information (30-45 minutes) 3. Pre-test counselling (30 minutes) 4. Client signs consent sheet 5. Blood extraction (15-20 minutes) 6. Wait for results (20-30 minutes) 7. Post-test counselling and results (20-30 minutes) ** 8. Reactive clients can immediately undergo CD4 count, CBC, urinalysis, hepatitis B test or return another day 9. Clients referred for chest x-ray at nearest external facility 10. Treatment provided once baseline tests are completed. If CD4 count is over 500 the client is informed that they may choose to start the treatment, if CD4 is under 500 treatment is strongly advised but a client my still refuse.	1. Client completes patient record form on iPad 2. Clinic staff encode and print the patient information and attach consent form (10 minutes) 3. Client verifies information and signs consent sheet. 4. Blood extraction (15-20 minutes) 5. Pre-test counselling / risk analysis. If client is new, they also attend HIV 101, a group education session (15-60 minutes) 6. Risk analysis and results issued to client (15 minutes) 7. Post-test counselling (10-20 minutes) 8. Referral to RITM or LoveYourself Anglo for baseline tests and treatment for reactive clients.	1. Client completes patient record form on iPad 2. Clinic staff encode and print the patient information and attach consent form (10 minutes) 3. Client verifies information and signs consent sheet. 4. Blood extraction (15-20 minutes) 5. Pre-test counselling / risk analysis (15-60 minutes) 6. Risk analysis and results issued to client (15 minutes) 7. Post-test counselling (10-20 minutes) 8. Reactive client's complete initial consultation with life coach (45 minutes) 9. Client can immediately undergo CD4 count, CBC, hepatitis B and syphilis test. 10. Referral to RITM for chest x-ray 11. Treatment provided once baseline tests are completed	1. Client completes paper-based patient record form 2. Pre-test counselling (10-15 minutes) 3. Client signs consent sheet 4. Blood extraction (15-20 minutes) 5. Wait for results (20-30 minutes) 6. Post-test counselling and results (30 - 40 minutes) 7. Reactive clients referred to appropriate facilities for baseline labs 8. Treatment provided once baseline tests are completed.
Staffing	2 salaried nurses 1 salaried encoder/ receptionist 1 salaried doctor 1 government funded med tech 1 NGO funded med tech 5 volunteer counsellors - 2 MSM, 1 female, 2 TGW (small amount of compensation is awarded)	1 volunteer receptionist 2-5 volunteer peer counsellors – MSM or TGW and HIV negative *** 4 salaried nurses 2 salaried med techs	Up to 15 volunteer counsellors + receptionist depending on availability - MSM or TGW and HIV negative 1 salaried doctor 1 part time doctor (on call consultant) 5 volunteer doctors 5 salaried nurses	1 salaried doctor 1 volunteer doctor 2 salaried med techs 5-10 volunteer counsellors 2 salaried encoders/ receptionists
Promotion	Social media advertising Community-based screening	Social media advertising Loveyourself website Community-based screening Loveyourself communications team	Social media advertising Loveyourself website Community-based screening Loveyourself communications team	Social media advertising Community-based screening

* Avg. client intake calculated using clinic registration data from Oct 2016 to Oct 2018 for LoveYourself Anglo, Uni and DRHWC and clinic registration data from Oct 2016 to March 2018 for Klinika Bernardo.

**According to the national guidelines for rHIVda, results should be given to reactive clients after confirmation by Western Blot, however in all HTC study sites results are given to reactive clients and baseline labs conducted before confirmation by Western Blot to reduce risk of client drop out.

***678 LoveYourself volunteers in total in November 2016 who work across all clinics, promotional and community-based screening events.

1.7 Role and Contribution

The idea to use digital games to promote HIV services among young key populations in the Philippines was first conceived by Dr Emmanuel Baja, a clinical epidemiologist at the College of Medicine, University of the Philippines. While undertaking research activities in the City of Davao, members of the city health office and DRHWC informed Dr Baja of a series of HIV cases among young males who were soliciting themselves to fund their online gaming habit. From this observation and knowledge of the HIV epidemic Dr Baja theorised that a digital gaming platform could provide an effective means to advocate HIV services and reduce risky behaviour. In April 2015, Dr Baja reached out to the ETCH unit. The ETCH unit was co-founded by Dr Marlize Coleman, Dr Edward Thomsen and I in 2014. The unit was set up to support research groups in the development, evaluation and roll out of games for health in lower- and middle-income contexts by bringing together expertise in game design, education and health. My primary role within the ETCH unit was to provide methodological expertise for the game design and evaluation.

In 2015 we set up the HIV GET Tested project team (Figure 1-7) and received joint funding from the UK and Philippines Government[9] for a 3-year project amounting to £592,250. I co-ordinated the grant proposal writing.

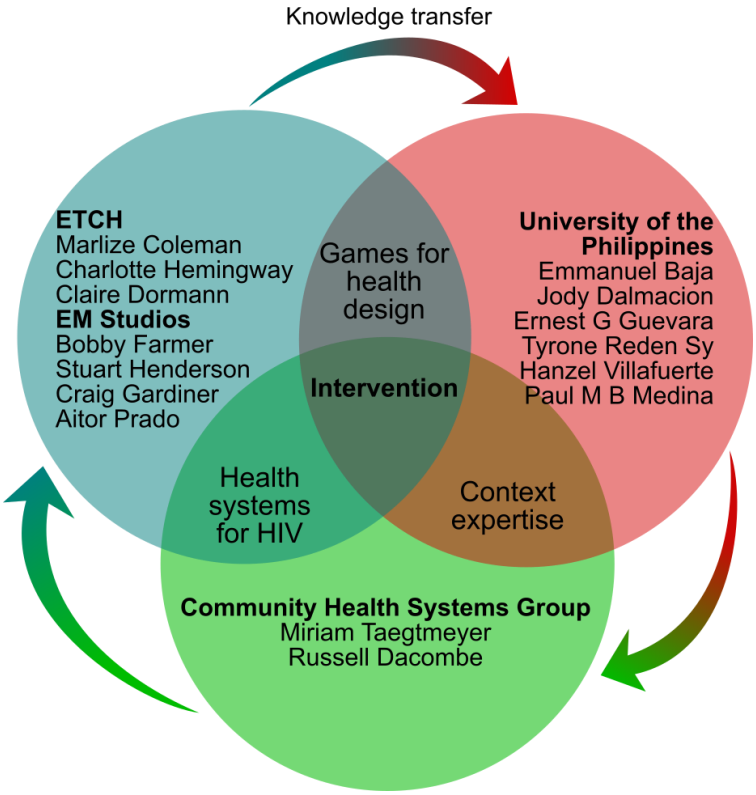


Figure 1-7: HIV GET Tested team

[9] Newton Fund UK-Philippine Joint Health Research Call - https://gtr.ukri.org/projects?ref=MR%2FN019202%2F1

I directed the UK budget of £355,368. Working with LSTM's legal team, I established a technical service agreement with EM Studios worth £102,400. This covered the cost of eight months employment of a digital artist, 12 months employment of two programmers, license costs for pre-built assets, game hosting and back-end analytics. The remaining UK budget covered salary and travel costs for academic staff at LSTM. The Philippines' budget of £236,881 was directed by Dr Baja. This covered the cost of in-country data collection activities including the employment of two Filipino research assistants, Ernest G. Guevara and Tyrone R. Sy for three years.

Formative Research

In 2016, formative research with MSM and TGW in the National Capital Region was conducted to explore enablers and barriers to HIV services. I conducted the initial literature review and developed a topic guide for the semi-structured interviews with input from the HIV GET Tested team (Appendix 1). Recruitment and data collection were managed by academic staff at the University of the Philippines. The interviews were conducted, transcribed and translated by the Filipino research assistants. Dr Baja was responsible for training the research assistants. I collaborated with the Filipino research assistants to conduct a thematic analysis of the data. I facilitated a 4-day workshop with the HIV GET Tested team to translate findings from the formative study into a game design, utilising guidelines set out in published literature on games for health design.

Game Design and Development

I worked closely with HIV GET Tested team to direct the user-centred design process for the game. I conducted training sessions with Filipino colleagues on user-centred design techniques and usability testing. I facilitated in-country participatory design workshops with Dr Baja and Professor Eufracio C. Abaya, a specialist in educational and psychological anthropology at the University of the Philippines. I used outputs from the formative research and design workshops, with guidance from the HIV GET Tested team, to develop a game design document. The document provided a blueprint for the artist and programmers at EM Studios to build the game and back-end analytics. I took on the role of producer and worked closely with the development team giving feedback and direction on a weekly basis. I was supported by Bobby Farmer, the managing director of EM Studios, to ensure design solutions were feasible in the available development time and budget.

I facilitated in-country extended playtests and FGDs with Dr Baja, Mr Guevara and Dr Medina[10]. I collaborated with Mr Guevara to analyse the video footage and FGD transcripts to improve the game design and determine the game's acceptability among target users.

[10] Dr Taegtmeyer, Dr Dalmacion and Mr Sy all attended one of the extended playtests to give feedback and guidance on the session.

Recruitment and transcription throughout the user-centred design process was managed by Mr Guevara.

My Filipino colleagues provided important local perspectives and insights throughout the user-centred design process. The presence of the Philippines' research team during the workshops and playtests enabled participants to express themselves in Filipino. Questions would be delivered in English; on the spot translation would be provided as and when needed. English proficiency is high in the Philippines, especially among young Filipinos; however, some participants did not feel confident expressing themselves in English, thus the presence of the Philippines' team directly improved the quality and depth of information I was able to obtain from interactions with target users.

I used the back-end game analytics to monitor game uptake and use. Custom software was built by EM Studios that enabled me to export the raw data from the Unity Analytics service into excel. I led the quantitative analysis with input from the HIV GET Tested team. I consulted with legal experts to ensure data collected through the game complied with the 2016 European Union General Data Protection Regulation (GDPR).

I am the first and corresponding author for a manuscript describing the development process for the game (Objective 2 & 3). The manuscript was formally accepted and published in the Journal of Medical Internet Research: Serious Games (Appendix 9) [58].

Game Launch and Promotion

I managed the app store pages for the game on behalf of the University of the Philippines. The marketing campaign for the game was directed by Hanzel Villafuerte, managing director of a PR consultancy firm in the Philippines. I supported the development of a press release and took part in a series of TV, radio and press interviews. Efforts made by the Philippines team to establish and run promotional activities were integral to the game's uptake. I presented project findings at stakeholder forums in the Philippines and UK and met with members of the PDOH on an annual basis to update them on project activities and findings.

Game Evaluation

I conducted 25 in-depth interviews with game users in the NCR and Davao City to explore the effect of the game on target users. I led the analysis and write up of findings from the interviews.

I supplemented findings with quantitative measures of game use and HTC service use at the four study clinics. I mapped the HTC study clinics and consulted with clinic staff to establish a set of indicators to monitor service use among young key populations. I developed a survey tool (Appendix 8) administered at the study clinics to monitor game use among HTC clients. I conducted the first round of data collection at the clinics in November 2017, Mr Guevara completed the consecutive rounds.

Ethics & Project Management

Ethical approval for the project was obtained from ethics committees at the University of the Philippines College of Medicine and Liverpool School of Tropical Medicine (Research Protocol 16-017). I co-ordinated the ethics application and subsequent revisions including development of the protocol and data collection tools for the entire HIV GET Tested project.

rHIVda Validation Study

Roughly £80,000 of the Philippines budget was used to strengthen capacity at the four study clinics to support the implementation of the rHIVda validation study. Dr Baja facilitated the production of training material for the testing algorithm and purchased computer and network equipment for each clinic. Remaining funds were given to the National HIV/AIDS and STI Prevention and Control Program for the purchase of rHIVda test kits.

1.7.1 Working Within the Confines of a Funded Research Project

This PhD project was undertaken within a funded research project. The aims and objective of the Newton Fund grant were as follows:

To pilot and support innovative methods (gaming and rapid diagnostic algorithm platforms) to increase the number of MSM knowing their HIV status.

Objectives in chronological order

1. To partner with the PDOH and local government to support current and future implementation of the new rHIVda.
2. To identify the perspectives of MSM HTC service users and MSM HTC non-users on enablers and barriers to HTC.
3. To map HTC services to determine the gaps that could contribute to the lack of MSM knowing their HIV status.
4. To develop and pilot a digital advocacy game that responds to identified barriers to HTC and/ or gaps within HTC services.
5. Monitor no. of HTC service users and explore motivational factors and acceptability of RDTs and gaming among MSM HTC service users.

The PhD study was embedded in this project and addressed most but not all of the objectives stated above. My formal role in the project was Technical Research Assistant and Co-Producer for the gaming intervention. I was responsible for both the delivery of my PhD study and the delivery of a tailored digital game and pilot study to improve HIV related practices. Dr Baja and Prof. Taegtmeyer[11] were joint principal investigators (PIs). The research focus, intervention and target population were established by the joint PIs through consultation with the wider team. The budget for in country research activities was managed by Dr Baja,

[11] Dr Marlize Coleman was the original UK PI, Prof. Taegtmeyer took over the role at the end of the first year of the project, prior to that she was a co-investigator.

therefore any in-country research activities within my PhD study that incurred a cost had to be within the scope of the Newton Fund grant.

While I was under obligation to develop a game-based intervention, deployed in the Philippines and targeting HIV, I had control over the target audience, learning objectives, underlying conceptual framework and distribution strategy. For example, during protocol development we discussed the possibility of developing a game targeted at health workers to improve practices at HIV testing and treatment clinics and agreed that we would pursue this option depending on conclusions drawn from the formative research.

1.7.2 Positionality

Within positionality theory, it is acknowledged that people have multiple overlapping identities which shape the research process [59]. I am deeply affected by the way I am perceived and have a strong desire to feel accepted. I flaunt or repress aspects of my identity depending on the company I am in and what I hope to achieve from the interaction.

When interacting with study participants who identified as gamers, I found myself drawing on my own identity as a gamer to establish rapport. Before beginning the formal research process, I would spark up a conversation using language synonymous with video game culture. I found this to be a very effective method to minimise the perceived separateness between myself as a British cisgender female and the Filipino cisgender male or TGW study participants. When the discussion entered the realms of sexuality, I would draw on my identity as a sex-positive bisexual, using subtle references to my own experiences and LGBTQ culture to encourage the participants to speak openly about their sexual practices and beliefs.

For participants who were not proficient in English I was acutely aware of the language barrier and how it limited my ability to establish rapport, in these instances I would encourage Dr Baja or Mr Guevara to lead the discussion. Participants would speak in what is colloquially known as *Taglish*, a portmanteau of the word's Tagalog and English. After learning a few basic phrases in Tagalog I was able to follow the conversation, take notes and ask follow-up questions without the need for translation in most instances.

My role within the project brought with it two conflicting identities. As a researcher I felt an obligation to provide an unbiased assessment of the game, as the co-producer I had a vested interest in its success. I was particularly conscious of how my identity as the co-producer would influence responses given by the study participants. I had experienced the characteristic Filipino adversity to disagreement on numerous occasions and therefore found myself questioning any form of positive response to the game, unsure on whether my position was the key motivation behind their response.

It is not possible to avoid bias in qualitative analysis as it is by its nature a subjective interpretation of the words and actions of another; nor is it possible to prevent participants

basing their response on what they believe will be most acceptable to the researcher. The best I could achieve was an appropriate level of awareness and reflection on how my identify as the co-producer influenced the data and interpretation of results and seek out methods to mitigate the inherent bias.

Within the HIV GET Tested team I was positioned as the superior knowledgeable outsider by my Filipino colleagues. This relationship dynamic was established from the outset of the project as Dr Baja made clear his dependence on the ETCH unit to make his idea a reality. I saw myself as inferior given my relative experience conducting research and distinct lack of local knowledge. If I was to be effective in a leadership role it was vital that I capacitated my Filipino colleagues to act as co-producers of knowledge while retaining the confidence needed to make final decisions. I took a democratic approach to the game design process and made efforts to ensure each member of the team felt empowered to put forward their own ideas and that time was taken to discuss the appropriateness of each design solution to reach agreement.

I was exposed to the world of global health research at a very young age. As the daughter of a single parent and world-renowned vector biologist I could often be found entertaining myself in an array of international research, health and government institutes as my mother worked. These early experiences sparked a curiosity into other cultures and a passion for travel to places off the beaten track. In 2009 I spent four months as a volunteer horse riding instructor in Phnom Penh, Cambodia. I worked in partnership with a HIV charity providing free lessons in riding and equine care for children impacted by HIV. These experiences exposed me to the realities of low-resource settings which in turn shaped the way I conducted myself when speaking with health workers in the Philippines.

When I wasn't with my mother and the so-called liberal elite in the jet-setting world of global health, I existed in the diametrically opposite world of rural Wales with my conservative grandparents. My upbringing has made me sensitive to a wide variety of political and moral views. While I will stand firm and advocate for the liberal views I hold around sexuality and equality, my relationship with my grandparents has enabled me to empathise and respectfully communicate with people who hold opposing views.

1.8 Thesis Outline

Figure 1-8 presents on overview of the thesis and a summary of content within each chapter. The thesis presents three linked studies (blue boxes) and is preluded with an introductory chapter. Chapter 6 concludes with a discussion to synthesise the findings from each study into a set of guiding principles for the design and evaluation of behaviour change games.

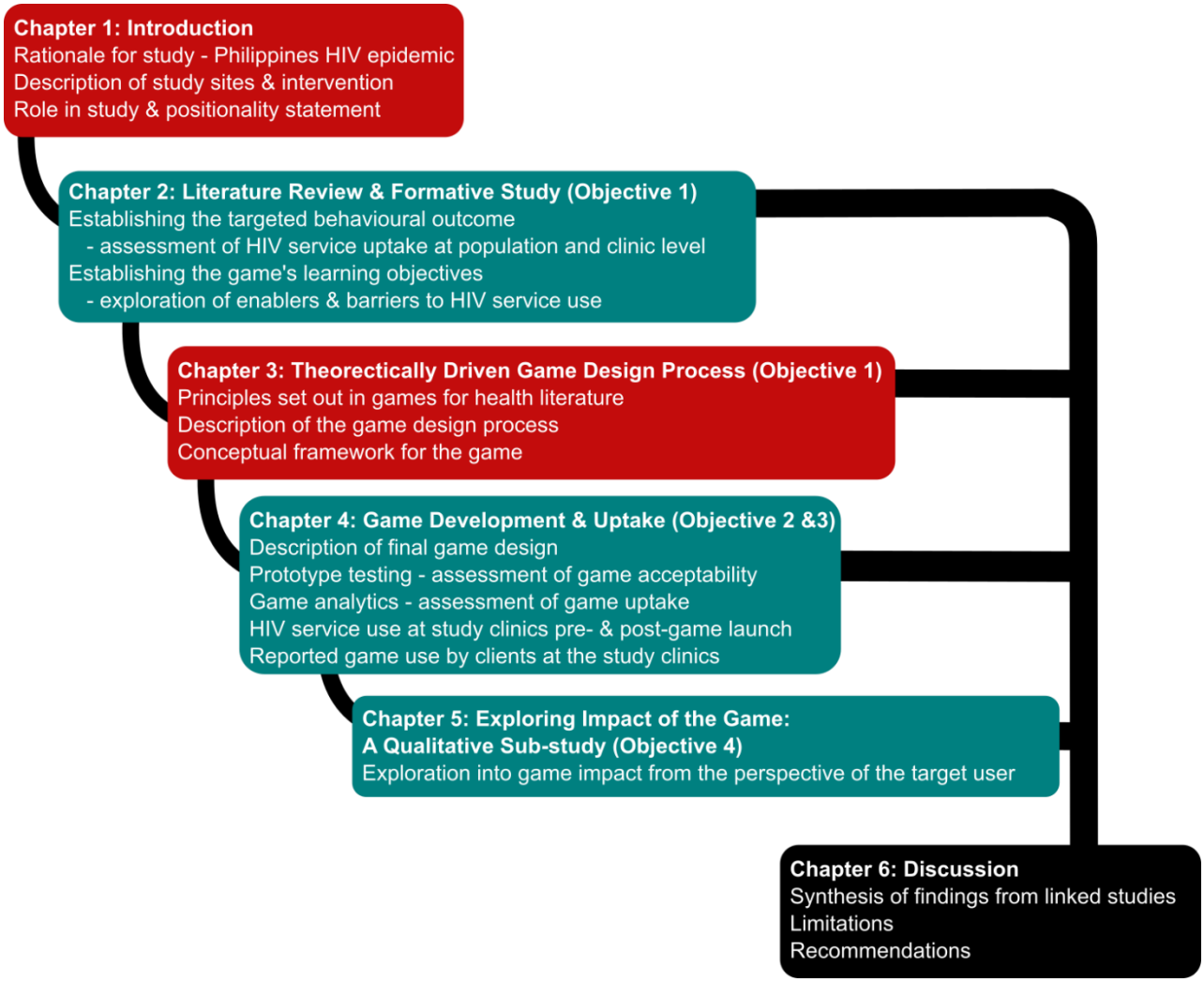


Figure 1-8: Thesis outline

1.9 Project Timescales

Figure 1-9 cross references sections of the thesis to present the timing of each activity and the order in which they occurred.

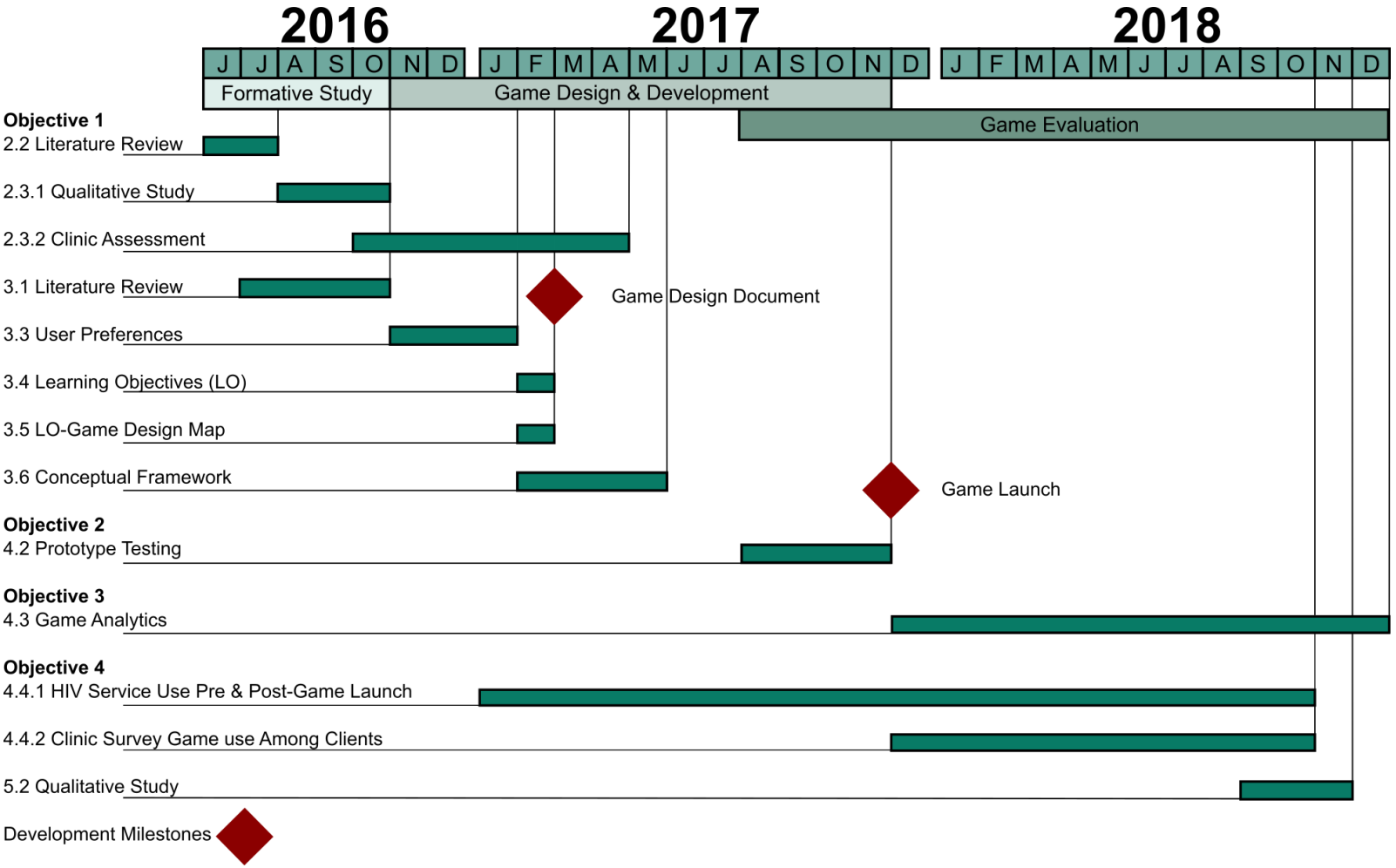


Figure 1-9: Project schedule by thesis section

Chapter 2: Literature Review & Formative Study

The last chapter set the scene of a sharp rise in the incidence of HIV among young MSM and TGW in the Philippines over the last decade and the public health response. This chapter presents how findings from literature, clinic registers and interviews with MSM and TGW were combined into a single formative study. The aim of this formative study was to define gaps in HIV prevention and treatment initiatives for key populations in the Philippines which could be exploited in the game design process (objective 1).

2.1 Introduction

This chapter is divided into two sections, beginning with a literature review to explore HIV service uptake and the underlying intrapersonal, social and structural determinants in the Philippines context. The literature review begins by describing the Philippines' progress towards the UNAIDS 90 90 90 target in general, among MSM and TGW and young populations. This is followed by a targeted review of published literature on enablers and barriers to HIV service use in the Philippines and discusses the limitations of population level reports and context specific literature to inform the game design and outcome objectives. The second section of this chapter presents a formative study, consisting of a small-scale qualitative study on enablers and barriers to HIV services among MSM and TGW in the NCR and assessment of the four study clinics combining data from the clinic registers with findings from the clinic mapping exercise presented in section 1.5.1.

The chapter concludes with a discussion on how the literature review and formative study, individually and together, contributed to the development of the game's overall aim and how the HIV GET Tested team used the findings, combined with knowledge of relevant behavioural intervention theory, to decide on what to take forward into the next steps of the game design process.

2.2 Literature Review: HIV Service Uptake (June – July 2016)

The aim of the literature review was to determine what was known about HIV service uptake and underlying determinants among key populations in the Philippines. Outputs from the review were used to make recommendations for the game design and further formative study.

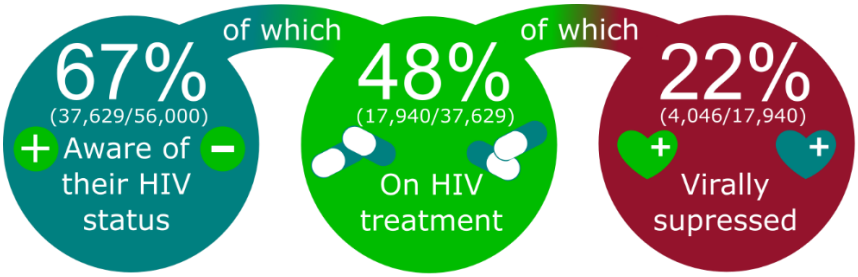
Search strategy

A Google search was conducted to obtain Philippines' national guidelines, reports and web pages relating to HIV service use. Key informants from government units in the Philippines helped direct the team to relevant published reports. Additional searches were conducted for non-governmental reports. A search for relevant studies was conducted in MEDLINE, Google Scholar and PsycINFO databases from January 1984 up to December 2016 using the following terms: [MeSH descriptor: "HIV Infections" explode all trees OR MeSH descriptor: "HIV" explode all trees OR "human immunodeficiency virus" ti,ab,kw OR "AIDS" OR "acquired

immunodeficiency syndrome" ti,kw,ab] AND ["uptake" OR "use" OR "coverage" OR "utilisation"] AND ["test*" OR "screen*" OR "detection" OR "treatment" OR "prevent*"] AND ["Philippines" OR "Southeast Asia"]

2.2.1 Philippines' Progress Towards the 90 90 90 Target: Falling Behind

In 2016, reported national figures presented a HIV response falling well behind target. The dismal figures highlighted a lack of quality data and adequate health information systems (Figure 2-1) [60].



Source: Philippines HIV/AIDS Registry - January 1984 to December 2016

Figure 2-1: 2016 reported progress against UNAIDS 90 90 90 target, general population Philippines

Progress against the 90 90 90 targets for MSM and TGW populations were similar to the general population at 63% (28,821/46,052), 49% (14,171/28,821) and 22% (3,179/14,171) respectively; while the proportion of those diagnosed was slightly less than the national aggregate, conversely reports showed slightly better linkage to care among MSM and TGW [60,61].

The third target, 90% of those on treatment virally supressed, requires sustained virologic monitoring to verify treatment success. The Philippines, like many low- and middle-income countries, has limited availability of viral load testing [62]. Of the 17,940 on treatment (Figure 2-1) only 4,395 were tested for viral load, while 92% (4,046/4,395) of those tested were virally supressed, the extent of missing data makes it difficult to draw any conclusions, and potentially leaves challenges in treatment adherence and drug resistance hidden. The reasons behind the low number of viral load tests conducted are not well reported, information sourced from multiple websites points to the following potential factors; people living with HIV being unable to afford a viral load test[12], treatment hubs using CD4 count as the preferred method to monitor ART response and the decentralised health system resulting in disparities in health service provision [63–65].

The Philippines' 5th AIDS Medium Term Plan (AMTP) included the following objective: 'Capacitate service providers in the delivery of quality and comprehensive programmes/

[12] In June 2015 PhilHealth released a circular which contained guidelines for the reimbursement of Out-Patient HIV/AIDS Treatment (OHAT) Package. The guidelines stated that 'viral load (if warranted)' was included in the OHAT Package. Despite this, reports surfaced that some treatment hubs would still charge PhilHealth members for a viral load test.

services on treatment, care, and support [66].' In addition to this the PDOH has publicly adopted the UNIADS 90 90 90 target, and in progress reports, state that routine viral load testing is being implemented [67]. While reports suggest attempts are being made to improve treatment response monitoring, there is little evidence to show these are anything more than promises on paper with resource constraints in a decentralised health system likely to impede progress.

Young Populations

Review of the MSM and TGW care cascade by age indicates very low uptake of HIV diagnostic and treatment services by those aged 15-24-years compared to the general population. Of the 28,821 MSM and TGW diagnosed nationally by 2016, 4% (1,040/ 28,821) were aged 10-19-years old, and 26% (7,593/ 28,821) were aged 20-24 [60]. In a report by the PDOH Epidemiology Bureau, it stated that only 3% of the estimated 15-19-year olds living with HIV were on treatment and 11% of 20-24-year olds [60]. However, the accuracy of this estimate is unclear given the ambiguity of the data source. The data source is quoted as Spectrum-AIDS Epidemic Model (AEM), May 2017 & HIV/AIDS & ART Registry of the Philippines (HARP), December 2016, yet the total number of people living with HIV on treatment is not disaggregated by age in the December 2016 HARP and extensive searches were unable to provide clarity on how these estimates were reached.

2.2.2 Enablers and Barriers to HIV Services in the Philippines

Breaking down barriers to HIV services among at-risk groups requires identifying key determinants of HIV service use in the Philippines' context and examining the scale and durability of the obstacle, to assess if any weak points exist that could be exploited by the game. At the start of the project in 2016, published context and population specific studies on determinants of HIV service uptake were very limited, there was just two relevant studies identified [48,68]. To address this evidence gap, qualitative evidence on enablers and barriers to HIV services was extracted from multiple sources; beginning with the small number of relevant published studies on MSM and TGW populations in the Philippines, followed by identification of further potentially relevant themes drawn from synthesised evidence from contexts elsewhere. Themes extracted from the literature were then used to inform the development of interview topic guides for a small-scale qualitative study with MSM and TGW in the NCR.

The explorative enquiry was structured around two interconnected constructs: cognitive determinants (factors associated with an individual's knowledge, beliefs, and reasoning) and the environmental conditions that either enable or hinder certain behaviours (structural, economic and socio-demographic conditions) [69]. Ultimately, behaviour is best understood in terms of an individual's perception of their social environment. What follows are themes

deemed to be of relevance due to their association with individual knowledge and reasoning which the game can be designed to influence and the structural and social conditions in the Philippines' context which underpin them.

Barriers to HIV Services Among MSM and TGW in the Philippines

In a 2015[13] qualitative study on enablers and barriers to condom use and HIV testing among MSM and TGW by the Philippines Department of Health (PDOH) Epidemiology Bureau, they reported fear and anxiety over a positive result as a primary reason for not getting tested [48]. Quotes included in the report suggested the fear stemmed from real and imagined consequences of testing positive; however, the commentary and illustrative quotes fail to describe the real-world experiences which generated this fear. Respondents hint at possible social exclusion resulting from positive diagnosis but provide no narrative evidence for this subjective truth. In a 2016 discursive-material analysis of negotiating agency among HIV-positive MSM, findings highlighted pervasive experiences of enacted and internalised stigma among HIV-positive MSM in the Philippines in the context of a powerful religious moral order dictated by the Roman Catholic Church [68]. Combined, these studies indicate the presence of dual stigma faced by HIV positive MSM in the Philippines which acts as a deterrent to knowing one's status or a feeling of comfort in not knowing.

Additional barriers to HIV services among MSM contained within the 2015 PDOH report centred around knowledge of HIV and HIV services. While the quotes provided in the report demonstrate that some participants held harmful misconceptions and poor knowledge on HIV or where to avail for services, they fail to illustrate the authors claims on the inaccessibility of HIV information. Observations at the study clinics revealed that all four clinics had an active social media presence and ran targeted and professional promotion of HIV services across multiple platforms including print and online mediums. The study fails to explain why individuals are not engaging with this information and appears to jump to assumptions on the quality and reach of existing campaigns. The study was also conducted prior to the rHIVda pilot, so perceptions of HIV testing services in light of newly available rapid diagnostics was missing.

Enablers to HIV Services Among MSM and TGW in the Philippines

The PDOH study identified peer encouragement and support during the testing process as a key enabler for getting tested [48]. The illustrative quotes demonstrated that several respondents had not undergone a HIV test because they were waiting for a friend to accompany them. The authors theorised that the lack of social support resulted from HIV remaining a taboo subject among certain social groups, meaning HIV testing was not commonly talked about or encouraged. This may also speak to the inaccessibility of social

[13] Study conducted in 2015, findings published in 2016. The report title indicates only MSM were included in the study but this is due to categorising the TGW as MSM.

media-based HIV information. Our online social network typically comprises of individuals with shared interests, which in turn influences prominent content on the social media platform. Therefore, HIV related information will only be visible to those who connect with relevant social media accounts.

An internal driving force to HIV testing identified in the PDOH study was the perceived risk of HIV and impact on their health. Awareness that HIV was a risk was predominantly drawn from news reports on the rapidly increasing HIV epidemic among MSM in the Philippines. Access to and the benefits of treatment were not reported as an enabling factor. In addition to this, the 2015 IHBSS reported very low awareness of available HIV treatment across all cities; 9% of MSM and TGW participants reported that they had heard of antiretroviral (ARV) medications in Manila City and Davao City. Although the questions use of technical language, i.e., ARV medications, could have left hidden those who are aware of HIV treatment but not aware of what the medication is called.

The methods deployed in the PDOH study provided confidence in the findings. Procedurally, the research team, comprised of psychologists, went through eight specific steps of data analysis: open coding, identification of initial themes, mapping/clustering and re-coding of initial themes; validation and re-coding of initial themes; coding based on a coding guide of validated themes; re-mapping and re-clustering of themes to produce the thematic map; validation of the thematic map, and writing up of the report. Of the 105 participants interviewed just over half (55) were aged 18-24 and the remainder over 25 years old, demonstrating good representation from young populations. Perspectives from TGW (20), heterosexual identifying MSM (17) and bisexuals (44) were also captured.

2.2.3 Literature Review Summary: Recommendations for Formative Study

Findings from population level reports on the UNIADS 90 90 90 target indicate a need for improvement across the HIV care continuum; however, a clear and concise outcome for the game is needed to ensure the scope of the design and evaluation remained feasible within project resources and precipitated a need to focus on just one of the 90 90 90 targets. As the gateway into treatment, addressing testing uptake would inevitably result in improvements across the care continuum, provided treatment remained accessible. In 2016, the Philippines fell well behind the target of 90% of people living with HIV knowing their status, especially among adolescents and young adults, demonstrating a need to increase uptake of HIV testing services among this group, for which a behaviour change game could provide a common-sense approach. Based on these findings, the targeted behavioural outcome was defined as undergoing HIV testing and counselling from a legitimate provider when the individual perceives they are at risk, with timely linkage to care if reactive.

While a game may be successful in influencing an individual's intentions to access HIV testing and treatment services the ability for them to act on these intentions would remain dependent on external conditions, notably the availability of HIV services. Assessment of the availability of HIV services in the study regions was therefore required. In contexts with weak and fragmented health information systems, population level reports cannot be relied on to accurately reflect uptake and performance at the clinic level. To address this limitation, findings from the clinic mapping exercise presented in section 1.5.1 were combined with clinic registration data to assess whether the four study clinics had the capacity to increase the number of tests performed and determine the availability of timely access to treatment if reactive.

The targeted literature review highlighted a distinct lack of evidence on determinants of HIV service uptake among key populations in the Philippines which could inform the game design. The rigorous qualitative methods and very large sample size deployed in the 2015 PDOH study provided a strong foundation for further exploratory enquiry. Missing in the 2015 PDOH study were perspectives on newly available rapid diagnostics and a clear understanding on social and structural conditions which perpetuate fear over a positive diagnosis. The inability to compare and synthesise findings from multiple studies ignited doubt on whether this was a comprehensive account of cognitive determinants of HIV testing uptake which could be taken forward into the game design process. Addressing these gaps would enable the development of context-specific learning objectives for the game, with narrative and health messages shaped in a way that was culturally relevant.

Identifying further lines of enquiry from contexts elsewhere

While determinants of HIV service use are nuanced with context-specific cultural drivers, there are aspects of human behaviour and reasoning which may be consistent across different contexts and populations. A popular view in social psychology of cultural differences in behaviour is that social norms differ across cultures but people from different cultures are similarly motivated to adhere to social norms [70]. While structural and social conditions remain an important construct in analysis of human behaviour there is still much to be gained from the lived experiences of others, especially if we consider that an individual's sexual identity may have a greater influence over the social norms they adhere to compared to their national identity. There exists a vast array of studies outside the Philippines exploring intrapersonal factors which either enable or deter HIV service uptake.

Substantial effort to synthesise the evidence has already been undertaken, providing a valuable resource to identify themes for further exploration in the Philippines context. Themes were extracted from three systematic reviews of qualitative evidence into factors associated with HIV uptake in general populations in Sub-Saharan Africa, Europe and MSM in Organisation for Economic Co-operation and Development (OECD) countries [71–73].

In the 2013 systematic review of qualitative findings on factors enabling and deterring uptake of HIV testing in Sub-Saharan Africa [71], the authors used Noblit and Hare's meta-ethnography [74]. First coined in 1988 for synthesising education ethnographies, Noblit and Hare's meta-ethnography method is one of the most frequently used for qualitative evidence synthesis in health and social care research [75]. Meta-ethnography is suited to developing new interpretations and concepts and goes beyond accumulation of information. This is achieved through the process of 'translation' where authors develop their own interpretations of first and second order constructs sourced from the literature and contemplate how concepts from different papers relate to one another. It is argued that this method provides a richer understanding of the phenomenon. The remaining two systematic reviews were aggregative, seeking to provide a summary of available evidence rather than an interpretive synthesis [72,73]. In the 2011 review by Lorenc et al. the authors only included articles with MSM in the sample or disaggregated outcome data, or which focused on services aimed at MSM in OECD countries [72]. Articles also had to include primary qualitative views data regarding perceptions and attitudes to HIV testing. In the 2010 review by Deblonde et al. the authors included any article published in English between 1997 and 2008 in a peer-reviewed journal which reported HIV testing barriers in Europe as a primary study endpoint, regardless of practice setting, methodology, response rate and other bias [73]. Given the different methods deployed and contexts in question, variations in the findings were likely and therefore provided an extensive list of potentially relevant themes which could be taken forward. A list of cognitive determinants of HIV testing uptake were extracted from the three reviews and presented in Table 2:

Table 2: Cognitive determinants of HIV service uptake from contexts outside the Philippines

Enablers	**Source**
Testing and knowing one's status no longer associated with death but as a path to start treatment and prolong one's life.	67,69
Desire to eliminate uncertainty and the worry that comes with it.	68
Relating HIV testing to the value of responsibility to one's health and towards sexual partners, often associated with routine testing practices by MSM.	68
Testing as an integral part of marriage/ long term relationship preparation.	67,68
Awareness of free, convenient and confidential testing services.	67,69
Awareness of community-based, friendly, culturally competent, sex-positive, confidential testing services.	68
Peer pressure to test from important social spheres.	67
Barriers	
Low perceived risk of HIV through lay interpretations of risky sexual practices, trust in their sexual partner, adopting the negative HIV status of their sexual partner and a lack of physical symptoms.	67,68,69
Being seen at a testing centre synonymous with sexual promiscuity and assumed HIV-positive status.	67,68,69
Fear of social exclusion, detriment to quality of life and loss of important relationships resulting from HIV-positive status.	67,68,69
Negative perceptions of western medical technologies as instruments of subjugation or the 'devil.'	67
Perceived psychological burden of living with HIV.	67,68,69
Fear of adverse effect of positive diagnosis on immigration status.	69
Enablers and Barriers	
Heightened perceived risk of HIV infection, through lay interpretation of risky sexual practices, physical deterioration of health, knowing someone with HIV or poor health/ death of a sexual partner or child either elevated willingness to test or dissuaded individuals from testing, assuming they were already positive.	67,68
Perceptions of HIV testing service quality and accuracy, with negative perception acting as a deterrent and positive perceptions acting as an enabler.	67

The systematic reviews demonstrate that uptake of HIV testing is influenced by an array of often contradictory and inter-linked factors. For example, lay interpretation of risk can both encourage or discourage uptake of testing and a willingness to test can be undermined through a lack of trust in the healthcare system. The themes reflected those found in the 2015 PDOH study but also expanded on them to demonstrate that knowledge and expectations of treatment effect and HIV service quality can be an important prerequisite to taking direct action for the benefit of one's health. Lorenc et al. described findings related to uncertainty and denial as a 'contradictory mix of motivations' which made it difficult to identify what events or

experiences cut through the denial and precipitated action. However, the data did provide examples of cues and triggers which repeatedly resulted in getting tested such as entering a new relationship, the onset of symptoms or lived experiences of the consequences of HIV infection. What is clear from the synthesised evidence from contexts elsewhere and the 2015 PDOH study is that negative perceptions of life after a positive diagnosis is a major barrier to HIV testing.

2.3 Formative Study

2.3.1 Qualitative Study on Enabler and Barriers to HIV Services Among MSM and TGW in the National Capital Region, Philippines (August – November 2016)

Introduction

Individual semi-structured interviews were utlised to expand on determinants of HIV testing uptake extracted from the literature. A qualitative study was conducted among MSM and TGW in the Philippines to explore social and structural factors which underpin the pervasive fear of knowing one's status, present knowledge gaps concerning HIV treatment and testing services and the role of HIV service knowledge and perceptions in behavioural intent. Given the sensitivity of the topic in question we opted for individual interviews so participants would be able to speak openly about their experiences.

Data collection tool development

Lines of enquiry were informed by the 2015 PDOH study and synthesised evidence of factors impacting HIV service uptake among general populations and MSM from countries outside the Philippines. A topic guide for the interviews was produced which contained open-ended questions relating to perceptions of HIV infection risk, available HIV services and psychological, social and lifestyle implications of undergoing HIV testing. Given HIV testing is influenced by an array of inter-linked factors, to fixate on one area would have left key aspects of the decision-making process hidden. The topic guide for the interview can be found under appendix 1.

Recruitment and interview procedure

Participants were recruited in the city of Manila and Makati, both located in the NCR. Time location and snowball sampling methods were used to reach MSM and TGW participants. Locations included a gay café, gay bars, community support groups and a bath house.

Interviews were conducted in Filipino and English by two Filipino research assistants. Each in-depth interview was conducted in a venue chosen by the participant. Permission for an interview followed the principle of informed consent. The interviewer explained the nature of the study and assured the participant of confidentiality. Interviews were audio recorded with consent. Interviews were transcribed and translated into English by two Filipino research assistants proficient in both languages.

Analysis

Participants were categorised as either a service user or non-service user. A service user was defined as a participant that had been tested for HIV in the past two years at any available testing facility in the Philippines. Transcripts were analysed using the framework approach [76]. Codes and categories were developed by considering each line of the transcripts in an attempt to summarise what the participants were describing. The coding matrix was reviewed by the HIV GET Tested team as part of measures to ensure the accuracy of the analysis. Constructs within behavioural theory were applied to investigate the role of knowledge, culturally specific attitudes, subjective norms and behavioural control in accessing HIV services. Findings were compared and discussed by the HIV GET Tested team until agreement was reached on the themes identified.

Ethical approval for this study was obtained from the University of the Philippines, College of Medicine and LSTM.

Results

Fourteen semi-structured interviews were conducted with 11 MSM and three TGW. Eight were categorised as non-service users and six as service users. Of the six service users interviewed, two were tested at a LoveYourself clinic, one during an outreach screening event by LoveYourself, two at Hi Precision (private diagnostic clinic) and one at a private hospital. The age range of the participants was 21 to 48-years-old. The relationship status of respondents was mixed with ten indicating they were single, three in committed relationships and one was married.

Fear of negative psychological, social and lifestyle implications of knowing one's HIV status emerged as a prominent deterrent to HIV testing in the Philippines context. Commonly found triggers to undergo HIV testing were: knowing fellow MSM or TGW that had HIV or had died as a result of HIV infection; awareness of convenient testing services; and testing as a requirement for employment. Several respondents also associated HIV testing with the concept of responsibility to their health and the health of others. Most participants, including non-service users, demonstrated sophisticated knowledge on how HIV is transmitted and practices which increase HIV-infection risk such as multiple sexual partners, drug and alcohol use and condom-less anal sex. Five participants identified non-sterile needle use as a mode of transmission. With the backdrop of pervasive stigma towards sexual minorities and people living with HIV, heightened perceived risk of HIV infection acted as both an enabler and deterrent. Themes deemed relevant for the game design are described below.

Misconceptions of HIV treatment and poorly enforced anti-discrimination law perpetuate a feeling of comfort in not knowing one's HIV status

All 14 participants stated that fear over the consequences of a positive result was or could be a barrier to HIV testing. A non-service user stated the perceived psychological consequences of a positive result was the reason they had not been tested:

"If why I don't visit a testing centre yet or why I haven't decided getting tested yet? Well, part of me perhaps, tells me that if I were to know my status right now, if it turns out unfavourably, it might lessen my drive [ambition] in life." – Non-service user, bisexual male, 26-years-old

Heightened awareness of the potential consequences of a positive diagnosis elevated the fear leading some participants to reason that it was better to live in ignorance. Evidently, the sense of shame or the stigma attached to potentially having HIV is seen in the responses of nine participants (four users, five non-users). In the respondents' minds, it is accompanied by judgment from other people as well as the dual stigma that comes from being gay and HIV-positive:

"…even before getting tested, there's already this stigma towards gays, right? What more if the result turns out to be positive, seems like the discrimination would just be severe. Especially when that person becomes quite a popular figure in the community, like if the father is the mayor and then people would know that his son is gay and positive, it seems like the community will bat an eye [look judgementally] on that person, making him feel degraded. Like that." – Service user, bisexual male, 24-years-old

While there are laws protecting those living with HIV it is believed they do not go far enough to prevent discrimination, with many fearful of their future in employment, education and health care systems if they were to test positive. Participants touched on some of these issues during the interview as illustrated in the quote below:

"Some do not want to get tested, because what if you have HIV, and then your office will know, then that will be a reason to terminate you, although according to the Department of Labour, it is illegal to remove someone. But there are also other things that you should be afraid if you are positive and you would have records at RITM [Research Institute of Tropical Medicine]. You would be in trouble with your insurance company, because if you are insured by the company, what will happen if you get sick because of HIV-related reasons, you won't be able to receive the benefits of the insurance." – Service user, bisexual male, 34-years-old

In contrast to the apparent consensus on the detriments of knowing one's status, views on the benefits were varied and highlighted several misconceptions and negative perceptions towards available HIV treatment. Very few noted the availability or benefits of antiretrovirals (ARVs) as an enabling factor to knowing one's status. None of the participants expressed knowledge on the reduced risk of transmission obtained through treatment (U=U). Some participants associated the initiation of treatment with detriment to the individual's appearance and quality of life:

"Although I know that there are really good treatments available already, I had this friend who tested positive, so I was the only one who knows about his situation, so I know that he's on ARVs, and that's how I found out that

there are certain cocktails that won't really work well with your own metabolism—what I mean is with how your body reacts and metabolizes the drugs. So in such a way, the side effects are becoming severe like I saw him undergo muscle wasting and severe hair loss to the point that when we met each other again, I had difficulty recognizing him." – Non-service user, bisexual male, 26-years-old

Participants expressed divergent perceptions on the lethality of HIV, from drawing comparisons with diabetes to the belief that HIV has evolved rendering treatment ineffective:

"HIV is a disease, but it's a curable disease. That is my perception. It's not a deadly disease as compared to diabetes, which is more deadly based on the studies. It can be cured and the medicines are fortunately available in the Philippines." – Service user, bisexual male, 26-years-old

"From what I know, before, HIV was controllable, people could still survive, unlike now, HIV is more aggressive. And it's not just me. I have other common friends that also say that HIV's attack is really fast." – Service user, TGW, 45-years-old

Filipino cultural norm of seeking treatment only when one is sick

Participants noted that early HIV diagnosis may not fit into the Filipino cultural norm of low health seeking behaviour or seeking treatment only when one is sick:

"The Pinoy [Filipino] has an attitude that's like it's better for them not to know if they have it. That how Filipinos mostly think, right? You won't see in the culture of the Pinoy to have a regular check-up…Sometimes even if I feel something like, you know, I just let go of it because my feeling is that it will go away after several hours or a few days." **–** *Non-service user, homosexual male, 48-years-old*

This concept aligns with national figures highlighting late diagnosis as a prominent challenge in the Philippines with reports of 58% PLHIV having advanced HIV infection (CD4 cell count of <200 cells/mm3) at the time of diagnosis and 21% classified as late diagnosis (>200-<350 cells/mm3) in 2016 [60]. It may also provide explanation to the narrative responses of some participants who witnessed the physical deterioration of their friends on ARVs and who viewed HIV as a deadly disease which "*attacks fast*."

Testing as a communal activity

The communal nature of testing and the importance of a solid support system can be gleaned from the interviewee's narratives as seen among the responses of ten participants (six users, four non-users). The respondents spoke about how their anxiety was lessened by the fact that they were with friends whom they trusted. As noted by one respondent:

"I don't think that a person will go to the clinic by his own volition. He will go there because he has someone to go with…It is unlikely that a person will try to initiate on his own. As opposed to someone who has a group to

go with, there is a higher chance of actually going to the testing centre." – Service user, bisexual male, 34-years-old

Among the non-users, one shared how he accompanied his friend throughout the proceedings:

"I think he didn't mind or wasn't aware that it took that long because I was with him, talking to him, during the whole time that he was waiting for it." – Non-service user, bisexual male, 26-years-old

However, one of the respondents in their 40s shared that they do not feel that it is right to convince their friends to go through testing, because ultimately it is their choice and their lives demonstrating that for some HIV testing is viewed as a private activity.

Awareness of free rapid diagnostics

At the time of the interviews the Philippines rapid diagnostic algorithm (rHIVda) was in early stages of the pilot and only available at a select number of clinics in the NCR and Davao Region (see section 1.2). Service users that attended the LoveYourself Clinics stated that they received their results in 3-4 hours. This is in line with the average time reported by service providers from LoveYourself. For the two service users who were not tested at one of the rHIVda pilot sites it took between 4-7 days to receive their results.

None of the non-service users were aware that HIV test results could be given on the same day. Estimated time to receive results ranged from 3-4 days to two weeks:

"I'm not sure, maybe extraction of blood sample, apart from explaining the whole thing, information giving and counselling based on the responses about risky behaviours. There's actually clinics who gives out the result quickly, though I'm not sure if we have one here. As far as I know, the public testing that we have, you have to go back for the result, that's what I know." – Non-service user, homosexual male, 24 years-old

This implies that they have not accessed, or they do not have access to, information on the newly available rapid diagnostics that will allow them to make a practical decision on how to fit a HIV test into their schedule. Participants also noted that long waiting times could exacerbate anxiety felt over the results and act as a deterrent:

"Let me also add that waiting for the result would take a lot of time. That's one of the concern people has as to why they don't get tested, they have to wait before results are given, that actually makes a difference. I also remember that it was actually the reason why my friend doesn't want to get tested, because as far as what he knows, it would take too much time and that makes him uneasy, reason why he wanted to have someone to accompany him, so that he wouldn't worry too much." –Service user, homosexual male, 24-years-old

The cost of a HIV test was not highlighted as a prominent barrier; however, a service user who tested at a private clinic felt that one must pay for guaranteed discreet and confidential

services. Equally the credibility and accuracy of free testing services were questioned by some of the participants. However, for a majority of younger participants, availability of free testing services was seen as a key enabler.

Within our study, four participants stated that they personally did not know where to go for free and/or confidential testing. A further three participants observed that there may be members of the MSM community that did not test because they were not aware of the free testing and/or discreet services.

Belief that MSM and TGW should not be the only target for HIV information

One of the questions frequently asked by the interviewers was 'do you think men who have sex with men are at high risk of HIV?' While responses need to be interpreted with caution given the leading nature of the question it did highlight a sense of frustration that HIV information appears solely targeted at the MSM community. As illustrated by this response:

> *"Everybody is at risk. Whether or not you are male, as long as you engage yourself or expose yourself to people who are infected with HIV, you will be at risk. So it does not mean that if you are gay, you are right away at a higher risk. Even straight people will be at risk." –Service user, bisexual male, 34-years-old*

Conclusions

Findings from the qualitative study reflected many of the themes identified in the literature and provided additional contextually important information. The study highlighted the relevance of job prosperity and financial stability in an individual's decision to undergo HIV testing, with poorly enforced anti-discrimination law exacerbating concerns.

When exploring the construct of knowledge, the dominant view from the participants was that a lack of awareness on where to avail for free and confidential HIV testing was not due to the accessibility of information but a lack of impetus to seek out the information. It also indicated that information on newly available rapid diagnostics is only reaching those who are already engaging in HIV services. Participants of this study demonstrated much greater and more accurate knowledge on HIV and risk of transmission compared to the 2015 PDOH study, although the heightened knowledge of HIV risk did not automatically translate to increased motivation to undergo HIV testing, with fear of the social and personal implications of a positive diagnosis remaining a prominent barrier. The contrast in reported knowledge may be a result of the sampling methods used. Snowball sampling is likely to result in the recruitment of participants who operate in the same social field and have a similar socio-economic status. Responses from the participants indicated that most had received a brief introduction to HIV in high school but only fully understood the personal relevance of HIV though peers, college seminars and the internet as further sources of information. Thus, we can not assume findings on knowledge from this study are representative of the wider MSM and TGW population.

Implications of findings from the literature review and formative study on the game design are discussed in the final section of this chapter (2.4).

Limitations

Of the participants interviewed six were in their 20s, five in their 30s and three in their 40s. Given the projects focus on adolescent and young adult key populations the participants sampled were not ideal as the views of those under 21 were missed, that is not to say that findings from the older participants did not have value for the game design. It also demonstrates that time location sampling will need to be supplemented or replaced with other sampling methods more conducive to reaching younger populations.

The recruitment strategy is likely to have resulted in a bias towards participants less encumbered by stigma towards their sexuality or HIV status. Snowball sampling resulted in participants sharing similar socio-demographic characteristics, with perspectives from individuals from low economic backgrounds and rural communities missed.

Some of the questions asked by the Filipino research assistants were potentially leading. Further training was conducted with the research assistants using transcripts from the interviews to improve their interview techniques for future data collection activities.

Certain terms used by participants did not have a direct English translation which, at times, led to ambiguity in the data during the translation process.

2.3.2 HIV Testing and Counselling Clinic Assessment (October 2016 – April 2017)

Retrospective analysis of HIV testing and treatment service use among clients self-presenting at the four study clinics was conducted to assess the availability of HIV services in the study regions in relation to clinic testing capacity and timely access to HIV treatment.

Data collection

Client registry data between the 1st of October 2016 and 30th of April 2017, representing four months (October – January) of testing data and seven months of treatment data (October – April), was obtained from the four study clinics. The following monthly summaries, disaggregated by age, gender and sexual practice (MSM/Non-MSM) were calculated for each clinic:

- the total number of clients tested for HIV;
- total number of reactive clients;
- total number of reactive clients who completed baseline tests[14] within 3 months of diagnosis, and;
- total number of reactive clients on treatment within 3 months of diagnosis.

[14] Baseline tests at all clinics at the time of the analysis included CD4 count, complete blood count, hepatitis B and syphilis testing and chest x-ray.

Data were collected from client registries housed on local servers at the clinics by either directly working with a clinic employee to extract monthly summaries from databases containing individual client records (Klinika Bernardo) or by a clinic employee independently entering the monthly summaries into a custom-built data entry form in Microsoft Excel (DRHWC, LoveYourself Anglo & LoveYourself Uni). Prior to data collection, meetings were held with senior clinic staff at all four clinics to explain how data would be used to monitor and report on trends in HIV testing uptake and linkage to care among young key populations during the lifespan of the project. No personal information was extracted from the client registries and access to the data was granted through a memorandum of understanding with each clinic. Ethical clearance for collection and use of anonymised aggregate clinic data was obtained from the ethics committees at LSTM and the University of the Philippines. Additional written approval for use of the data was obtained from associated local government units. As compensation for clinic staff time and access to the client registries, data visuals generated through analysis of the monthly summary data were shared with each clinic to freely use in any report or service promotion. Meetings with senior clinic staff were also used to clarify how client data was managed at the clinic and to identify limitations in the available data.

Analysis

Description of service use is presented separately for each clinic as heterogeneity in available services and practices were present. Descriptive analysis was conducted in Microsoft Excel v1812 to determine:

1. The total number of clients tested each month by age category at each clinic in the period 1st of October 2016 to 31st of January 2017. Testing capacity for each clinic was calculated using the total number of minutes available on clinic open days for blood extraction divided by 20 (max. time in minutes taken to extract blood based on clinic observations) x number of staff qualified to extract blood x number of days open per week x 4 to give a crude estimate of number of tests that can be conducted at each clinic per month.
2. Proportion of clients who report as MSM out of the total number of clients tested in the period 1st of October 2016 to 31st of January 2017 at each clinic. TGW clients were categorised as MSM as it was not possible to identify TGW from the client registers.
3. Proportion of those tested in the period 1st of October 2016 to 31st of January 2017 who received a reactive result.
4. Proportion of reactive clients in the period 1st of October 2016 to 31st of January 2017 who were initiated onto treatment within 3 months of diagnosis by age category. Clients referred to LoveYourself Anglo for treatment from other sites (including LoveYourself Uni) were excluded from the analysis. LoveYourself Uni refers all reactive clients to LoveYourself Anglo or the Research Institute of Tropical Medicine

(RITM) HIV treatment hub. Access to RITM's client registry was not obtained, therefore the proportion of reactive clients diagnosed at LoveYourself Uni and linked to care within 3 months has been excluded from the analysis.

Practices in data management also differed between clinics resulting in varying levels of confidence in the accuracy of the data and is discussed in the limitations.

Results

Between the 1st of October 2016 and 31st of January 2017 LoveYourself Anglo recorded 3,411 clients tested for HIV, almost double that of the government clinics and the highest total of 10-24-year-olds (1,258). LoveYourself Uni, a smaller facility compared to LoveYourself Anglo, recorded 2,827 clients tested for HIV, of which 1,138 were recorded as 10-24-years-old. At DRHWC, 2,047 testing events were recorded, of which 836 were recorded as 10-24-years old. Data available at the DRHWC was not sufficient to determine if the recorded number of tests conducted represented individual clients. At Klinika Bernardo 1,731 clients were tested for HIV, of which 769 were recorded as 10-24-years-old. Figure 2-2 presents testing uptake at the clinic in relation to the estimated testing capacity.

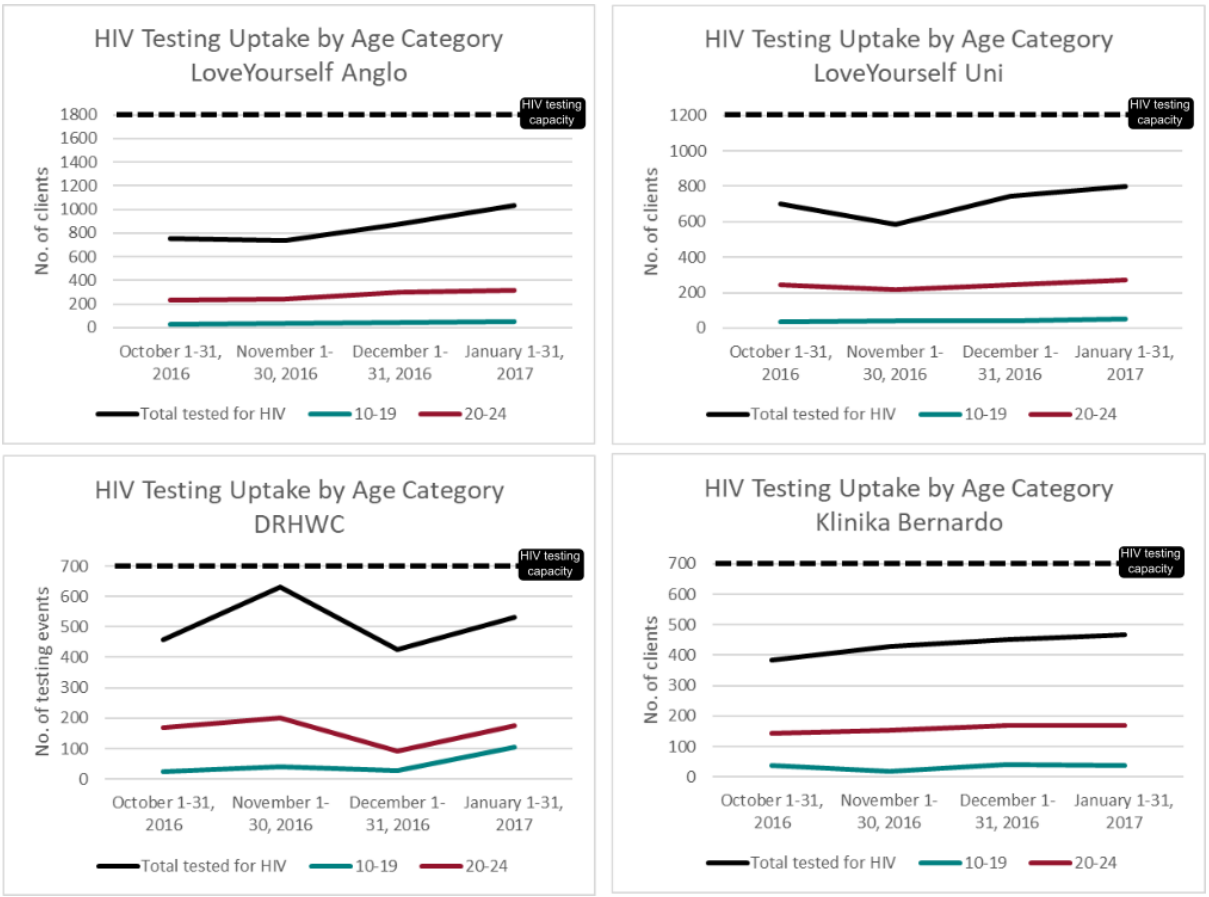


Figure 2-2: Testing uptake in relation to clinic capacity

The relative frequency of reactive clients at the clinics ranged from 4-9%. Of the reactive clients, 68% (212/310) initiated ART within 3 months of diagnosis at LoveYourself Anglo and 70% (57/81) at DRHWC. Reported linkage to care at Klinika Bernardo was significantly lower

compared to LoveYourself Anglo and DRHWC. Clinic staff believed there to be two reasons behind the client registry reporting only 31% (26/85) of reactive clients being linked to care within 3 months. Firstly, Klinika Bernardo's policy is to refer clients to alternative treatment hubs if a more suitable option for the client exists. The clinic was unable to confirm if referred clients had successfully enrolled on to treatment as no system is in place for them to track referrals. Secondly, several factors were present which often led to treatment being delayed beyond 3 months of diagnosis such as economic barriers in obtaining the necessary baseline test results and reactive clients with CD4 counts >500 being given a choice to delay initiation of ARVs. Factors which the clinic staff claimed motivated them to advocate for the local government to adopt the test and treat strategy.

All four clinics promoted young adult and adolescent MSM and TGW friendly services, through targeted advertisements and use of young MSM/ TGW counsellors. A vast majority of clients were recorded as MSM.

Limitations

At the LoveYourself clinics, data management practices provided confidence in the accuracy of the data. Clients registered their details in a Google Form using a tablet device provided at the clinic. Certain fields in the Google Form contained data validation. Details entered were cross referenced with a database to identify new or returning clients. This enabled the exclusion of repeat testers from the monthly summaries. Data stored on Google Drive and Microsoft Excel were kept securely and only designated members of staff had administrative access. At LoveYourself Anglo, treatment records were kept in separate databases and linked using a unique ID generated for the client at registration. The clinic was also able to present supporting documentation for data management.

Data management practices at DRHWC were not sufficient to ensure accuracy and completeness of the data. Individual records for non-reactive clients were kept on paper-based forms in an unsecure cabinet. Individual records for reactive clients enrolled on to treatment at DRHWC were kept on paper-based forms in a separate secure cabinet. A data entry operator employed at the clinic was responsible for inputting individual records into Microsoft Excel for reactive clients enrolled on to treatment at DRHWC only. The clinic held two digital databases, one containing the individual records of reactive clients on treatment and a second containing monthly summaries of the total number of clients tested for HIV disaggregated by gender (male and female only), age category and key population (FSW, MSM, IDUs & OFW). The clinic was unable to provide supporting documentation for data management.

At Klinika Bernardo, data were collected by clinic staff using paper forms. The clinic receptionist was responsible for inputting data from the paper-based forms into Microsoft Excel. Testing records were kept in one file and treatment records in a separate file. Patient records were linked using a unique ID which enabled the exclusion of repeat testers from the

monthly summaries. As neither file contained mechanisms to validate the data being entered, the accuracy of the data was dependent on the receptionist's competency.

Data quality at the clinics was varied which made it difficult to compare clinic performance between the four study sites. As I did not have access to figures on how many requests for HIV testing services were not fulfilled, I was unable to assess how successful clinics were in meeting demand. In DRHWC there was no way of excluding repeat testers from the monthly summaries. Limited availability of data on viral load meant that we couldn't assess if there were any challenges in treatment adherence among the HIV positive clients attending the clinic for treatment services. Estimated testing capacity at the clinics does not consider staff shortages, availability of peer counsellors and doctors, supply shortages or waiting room space and is therefore likely to be an over-estimate.

2.4 Discussion: Implications of Findings on Game Design

Establishing the target outcomes for the game

The literature review and formative work combined to focus the game's learning objectives on benefits of knowledge of status. Representative population data revealed low rates of testing among young key populations, assessment of clinic registration data combined with clinic observations revealed that study clinics were operating close to capacity. Client-initiated testing appears successful in attracting high numbers of MSM service users, especially in the NGO clinics. The relative frequency of reactive clients is to be expected given the concentrated HIV epidemic in the Philippines; however, this may also indicate that certain HIV-infected populations are not engaging in these services. Low levels of HIV testing access and uptake by adolescents and young adults can lead to late diagnosis and late entry into care and treatment [77]. Late diagnosis was identified as a prominent challenge in the HIV response [60].

Conversely, two of the clinics performed better than expected regarding linkage to care, 68% (212/310) of clients from LoveYourself Anglo and 70% (57/81) of clients from DRHWC were enrolled on to treatment within 3 months of diagnosis. Demonstrating that the study clinics are able to provide timely HIV treatment for reactive clients despite resource constraints.

The targeted behavioural outcome was established through assessment of 2016 population level data and defined as undergoing HIV testing and counselling from a legitimate provider when the individual perceives they are at risk, with timely linkage to care if reactive. The assumption was that this behaviour would lead to an increase in the proportion of PLHIV who know their status and a reduction in late diagnosis. This was recognised as the health outcome for the game. If the game invoked behavioural change at scale this could result in changes in HIV service uptake at the clinics. Observations at the study clinics indicate that they are working close to capacity, therefore any increase in the total number of clients will be

restricted. An increase in the number of adolescents and young adults (10-24-years old) getting tested and diagnosed with HIV could act as a proxy measure for a decrease in late diagnosis. Any change in HIV service uptake observed at the clinics could be the result of a wide range of factors, therefore measuring game use by clients attending the clinics would be required to identify whether the game was a potential factor in observed changes to HIV service uptake.

Providing an alternative narrative for life with HIV

Available evidence on enablers and barriers to HIV services strongly indicates that elevating perceived risk of HIV-infection alone is not sufficient to increase uptake of HIV testing. For the behavioural intervention to be successful it must address the perceived fear of a positive diagnosis, potentially by offering a convincing alternative narrative of what life can be after a positive diagnosis. Touching on important factors such as employment, relationships and morality.

Storytelling has long been established as an effective means of attitude change [45]. The immersive nature of digital games could further enhance narrative affect through transportation [78]. Transportation is where the narrative provides vivid personal experiences which engenders identification and an emotional response to characters, enabling the suspension of disbelief and reduction of counterarguments [79]. Qualities of interactive narrative games, where players progress or influence narrative direction through gameplay, may further enhance the transportation effect. Instead of passively witnessing a story unfold, players are given agency in the game world where their choices have consequences. This in turn has potential to influence key mediators of behaviour presented in leading theories of behaviour change. Social Cognitive Theory posits that our behaviour is influenced through observing the behaviour of others [50]. An interactive narrative could support observational learning by enabling players to model the action of undergoing or postponing a HIV test and witness positive and negative outcomes within a safe virtual environment. Another construct of Social Cognitive Theory is the belief in one's capability to repeat the behaviour of others. Allowing players to customise playable characters could foster stronger identification with the characters, thereby increasing a player's sense of personal risk or self-efficacy in overcoming barriers to HIV services. Positive portrayals of characters living with HIV may also help form beliefs that players can remain or become their desired self after a positive diagnosis. Re-framing HIV testing as an act of wisdom, responsibility and courage could help counter the ways in which morality gets in the way of testing.

Addressing misconceptions of HIV treatment

The formative study highlighted treatment as a weak counter force to the perceived negative implication of knowing one's status. A lack of knowledge on free available treatment and misconceptions drawn from lived experiences of peers who had been diagnosed late

contribute to this phenomenon. If individuals make health-related decisions using a cost benefit analysis approach, as assumed by the Health Belief Model [80], avoiding HIV testing becomes the obvious choice for those who are unaware of the options available to them after a positive diagnosis and are cognisant of the negative consequences knowing one's status could bring. If the game were to provide an alternative narrative on life with HIV it must incorporate the role of treatment to enable players to draw inferences between early access to treatment and quality of life; this in turn should strengthen treatment as a counter force to the perceived negative implications of knowing one's status.

Offering practical information to facilitate action

Relatively simple solutions could be integrated into the game to address the lack of practical information and understanding on the testing process. In Malcolm Gladwell's book: The Tipping Point; How Little Things Make a Big Difference, the author describes a study used to increase tetanus vaccinations among university students [81]. First, he compared high-fear information leaflets with low-fear and found no difference in their effectiveness to encourage individuals to vaccinate. He then compared leaflets with directions to the health facility and vaccination times to ones without and found a significant difference. The inclusion of practical health advice, enabling the individual to fit the vaccination around their schedule, was interpreted as the 'tipping point.'

Testing and treatment services in the Philippines are in a state of fluidity so it is important to ensure practical information on testing services is accurate and up to date. Digital content can be updated as quick as protocols change or clinics move buildings ensuring health information is in line with current practices. A digital game is therefore an ideal platform for the inclusion of practical information on available HIV services which could provide the so called 'tipping point.'

Supporting testing as a communal activity

The games potential to indirectly influence behaviour may also be found from the complex interplay between digital gaming and social behaviour [46]. Even a single-player game can trigger meaningful social interactions, from recommending a new game to offering advice on how to complete a challenge. For example, a player may recommend the game to a peer or family member who they believe could benefit from the health-related content. Narratives and characters within the game could also trigger meaningful conversations within social groups helping to break the silence around HIV. Such effect of the game could generate increased social support to undergo a HIV test which the formative study highlighted as an important enabling factor.

Presented here is the beginning of a theoretical basis for the game. The process used to translate findings from the formative research into a game design is presented in Chapter 3.

Chapter 3: Theoretically Driven Game Design Process

The previous chapter examined where a game-based intervention was most needed within the HIV care continuum and discussed how a game might influence important mediators of HIV testing uptake among young MSM and TGW populations in the Philippines. This chapter describes the process used to translate these findings into a detailed game design document and conceptual framework. It summarises guidance and principles set out in the 'games for health' literature and behavioural research and describes the stepwise process of determining user preferences, setting learning objectives, co-creating the learning objectives-game design map and developing the conceptual framework (objective 1).

3.1 Literature Review: Introduction to Developing and Evaluating Games for Health (June – November 2016)

At study inception in 2016 there was a paucity of relevant published studies on games for HIV-related behaviour change. To translate findings from the formative study into a game design we drew inspiration from experts in the field of games for health for other conditions, using experience and principles set out in published literature. Although an extensive body of literature exists it is fragmented. This fragmentation is a result of an emerging field of research which draws from expertise in pedagogy, psychology and game design, with each component presented in separate articles. This is further compounded by the fact that games for health differ in their scope, target audience and goals, which means approaches used in the design of other games cannot always be generalised. We focused on games aimed at influencing health-related behaviour and educational games which supported the transfer and retention of knowledge.

Search strategy

A search for relevant studies was conducted in MEDLINE, Google Scholar and PsycINFO databases from January 1984 up to December 2016 using the following terms: [MeSH descriptor: "video games" OR "gam*" ti,kw,ab] AND ["behaviour" OR "promotion" OR "health" OR "educati*" OR "learn*"]

3.1.1 Theoretical Foundations

In the relevant literature, it was recommended that design challenges are addressed through the application of theoretical frameworks in both game design and behaviour change.

Which game design elements are best suited for the transfer and retention of knowledge and attitude change?

Application of theoretical frameworks for the development of educational games (i.e. game-based learning theory) provide a structured approach to answering this question. The steps outlined in relevant literature involve establishing a set of learning objectives, mapping the learning objectives to pedagogical practice and then translating the pedagogical practice into

a mechanical element of gameplay, referred to in the entertainment games industry as a ‘game mechanic’ [82–85].

How might interaction with the game lead to effect on behaviour?

The structured approach to answering this question involves mapping out a causal pathway between interaction with the game and the primary outcome objective, incorporating; identification of key psychological processes of behaviour change and conceptualising the relationship between the behaviour change techniques deployed in the game, determinants of behaviour and the outcome objective (i.e. behavioural prediction theory). There are many existing behavioural prediction theories which can be utilised to identify key psychological processes; thus, the first step requires critical review of leading theories to determine which best fits the research questions and objective of this study.

Much of the behavioural research in games for healthy lifestyle promotion notes the application of four theories of behaviour or behaviour change in the design and evaluation [43]; the Health Belief Model [86], Social Cognitive Theory [50,87], Information-motivation-behavioural Skills Theory [88] and Theory of Reasoned Action [69]. These theories represent the cognitive perspective of behaviour change and share the assumption that attitudes, beliefs and expectations are major determinants of health-related behaviour. On the outset they appear a good fit for this study given the understanding that the game will target cognitive determinants of behaviour. While the four models noted above share the same underlying assumption they differ in their strengths and limitations due to the emphasis they place on certain variables.

The core assumption of the Health Belief Model is that individuals will take positive health-related action if they believe they are at risk of a detrimental health condition and that the perceived benefits of the health-related action outweigh the negative outcomes. The model is limited by the weight it puts onto four cognitions, perceived susceptibility, severity, benefits and barriers. The Health Belief Model makes the assumption that we are rational thinkers, and when presented with information that our wellbeing is under threat, will choose to take the necessary action to mitigate that threat. Evidence shows that these cognitions have only a small to moderate effect on behaviour, especially on habitual health-related behaviour [89]. This is also reflected in findings from the formative study in which heightened perceived risk of HIV acted as both an enabler and barrier to HIV service uptake. Gaming interventions targeted at adolescents must also take into consideration their relatively immature neurobehavioural systems necessary for anticipating the potential long-term consequences. Thus, making the Health Belief Model a poor fit for this study. Social Cognitive Theory also suggests that knowledge of health risks and benefits are a prerequisite to change but notes additional self-influence and environmental conditions necessary for change to occur. The basic principle of this theory is a continuous dynamic interaction between the individual, environment and behaviour which in turn shapes the individuals perceived self-efficacy,

perceived facilitators and barriers, outcome expectancies and motivation to enact certain behaviours. Due to its wide-ranging focus this theory can be difficult to operationalise. In contrast the Information-motivation-behavioural Skills Theory was developed to be generalisable and simple. The theory posits that the three components – information, motivation and behavioural skills – must be addressed for the behaviour change intervention to be effective. Lastly, the Theory of Reasoned Action differs from the previous theories by the emphasis it puts on behavioural intention and posits that intention is both the immediate determinant and strongest predictor of behaviour change. However, the theory omits the fact that behaviour may not always be under volitional control.

As the theories shared a number of overlapping variables - namely, outcome-expectancies, self-efficacy, social pressure and intention - combining constructs from across all of the leading theories could provide the predictive strengths from each model while mitigating the limitations. Fishbein's Integrative Model of Behaviour Prediction is a model conceived in 2008 which combined leading social cognitive models for health seeking behaviour - including Social Cognitive Theory, Theory of Reasoned Action and the Health Belief Model - in an attempt to identify a finite set of variables to be considered in any behavioural analysis [90]. The model is made up of two variable groups. Firstly, variables that are necessary for behaviour to occur which are; strong intentions, necessary skills to perform the behaviour and no external constraints that will prevent the behaviour. Secondly, variables that influence intention which includes; perceived advantages outweighing the disadvantages of the behaviour, a social pressure to perform the behaviour, a belief that the behaviour is consistent with or will improve self-image, a belief in a positive emotional reaction from performing the behaviour and strong perceived self-efficacy.

A key challenge for determining game effect in this study is the presence of a wide range of moderating variables that cannot be controlled. For example, in the specific context of developing a game that promotes HIV testing among 10–24-year-olds, while the game could be successful in increasing a player's willingness to undergo a HIV test, this willingness may still be undermined by restricted access to HIV services due to economic constraints, on which the game has no influence. Thus, the conceptual framework for the game may help in identifying proxy measures to evaluate game effect at a later stage (see section 3.1.2).

Heterogeneity in the application of game based-learning and behavioural prediction theory was present. Often games for health studies briefly mentioned which theory was used, but not how theoretical techniques were applied. This highlighted a need for more detailed process description on how theory is applied to the game design process. Addressing this gap would benefit stakeholders interested in developing theoretically driven games for health.

3.1.2 Evidence of effectiveness of Games for Health

A 2014 meta-analysis of 52 digital games for healthy lifestyle promotion from 54 papers found that games had small positive effects on healthy lifestyles and their determinants, especially knowledge; effects on clinical outcomes were significant but much smaller [43]. A 2015 meta-analysis for games for sexual health promotion found that only a few studies met the inclusion criteria, and of those that did, effects of behavioural outcomes failed to reach significance [91]. Meta-analysis of game effect appears at odds with qualitative anecdotal evidence of the motivational value of games. The repeated evidence of small effect sizes in games for health studies could indicate the following: validation through standard randomised control trials (RCTs) may not be sensitive to the games effect; the overall quality of games for behaviour change is poor; or there is no direct causal link between the games content and certain real-world health or behavioural outcomes.

There are two clear flaws in evaluating games through experimental design. The first is that experimental design assumes that the 'active ingredient' in the intervention can be isolated from the context, such that a proper control condition can be developed. Gameplay however is intertwined with the user's context. How one user interacts with the game and the psychological processes it invokes will not be the same as it is for another; thus the intervention becomes difficult to properly control for, as the control condition should be equal to the experimental condition in all aspects except the independent variable. In most instances, identifying the independent variable in a behaviour change game is not feasible. The second is that RCTs tend to compare participants at discrete timepoints, whereas behaviour change tends to evolve dynamically over time and is dependent on a number of conditions of which the intervention may have no influence. While the RCT remains the gold standard for determining an interventions causal effect, methodological flaws and existing evidence of behaviour change games effect denote a need to explore alternative evaluation methods. This study provides an opportunity to do this.

In the 2014 meta-analysis of games for healthy lifestyle promotion the authors also investigated the role of theoretically important moderators in game effectiveness and concluded that games underpinned by dual theory in game-based learning and behavioural prediction theory related to higher game effectiveness [43]. Analysis of effect sizes on behaviour, behaviour determinants (knowledge, attitudes, subjective norm, perceived barriers, self-efficacy, skills, or behavioural intention) and clinical outcomes was conducted. Studies which only reported clinical outcomes and no effects on behaviour and behaviour determinants were excluded. A majority of the studies (50) in the meta-analysis included behavioural determinants as an outcome measure, 21 included behaviour outcomes and 10 included clinical outcomes; this was as expected given the understanding that games for healthy lifestyle promotion are likely to have a direct effect on behaviour and behaviour determinants,

and determining causal effect on distant outcomes alone is challenging. Because of this, the meta-analysis is arguably more conducive to understanding moderators of game effectiveness in influencing determinants of behaviour.

The theory underpinning a game may influence its effectiveness. In the 2014 paper, analysis of the game's theoretical foundation as a moderator of game effectiveness found that the type of theoretical foundation mentioned in the paper, i.e., behavioural prediction theory, game-based learning theory, neither or a combination of both, significantly affected the effect size for behavioural determinants, but not for behaviour or clinical outcomes. Additional review of two studies included in the meta-analysis, which reported the highest and lowest effect sizes on behaviour determinants and contained the same health promotion challenge and outcome measures, revealed some interesting differences. On the top end of the scale was a 2009 paper on the design and evaluation of a computer game to promote healthy diet among young adults which reported the greatest effect size on behaviour determinants (knowledge, self-efficacy, perceived benefits and barriers, intention) [92]. The primary differences between this study and a 2008 study on the effectiveness of print, web-site and game modalities on nutrition literacy is the control condition used and the description of the game design process [93]. In the 2009 study, the game design process involved mapping the outcome objectives to structural elements of game design conducive to knowledge and attitude change and underpinning these with behaviour change theory e.g., increased self-efficacy was addressed through role play in a simulated environment and underpinned by Social Cognitive Theory [94]. The description of the design process for the game in the 2008 study was very brief in comparison and involved gamification[15] of key concepts from basic food-nutrition curricula e.g., users were instructed to calculate which food product is most cost effective based on the size of the food product, number of servings, and cost of the product and received points for correct answers. The second key difference between the two studies was the control condition deployed. The control condition for the 2009 study with the highest effect size was a no treatment concurrent control, for the 2008 study they used a between-subjects repeated measure design to compare the same nutritional information delivered through a game, a web-site and a pamphlet. Due to the fact that you would expect to see smaller effect sizes in studies which test different delivery methods for the same information compared to those where the control group is given nothing; it could be argued that the difference in effect sizes between the two studies in question was more to do with the control condition than the presence of a theoretical foundation in the design process. The meta-analysis demonstrates there is a correlation between the type of theoretical foundation mentioned in the paper and the

[15] Gamification - the application of typical elements of game playing (e.g. point scoring, competition with others, rules of play) to other areas of activity, typically as an online marketing technique to encourage engagement with a product or service.

effectiveness of the game, but caution must be taken when interpreting this finding from the synthesised evidence. It may be that the presence of theoretical frameworks in published material is indicative of a development team with a previous track record in games for health and a high level of investment in the game's success.

While limited, synthesised evidence on the effectiveness of behaviour change games indicate the presence of a complex mix of moderators from design to evaluation which need to be taken into consideration.

3.1.3 Guidance and Principles for Game Design

Determining user requirements

Formative research with members of the target audience may contribute important insights related to acceptability, accessibility and comprehension of the game for health; such insights may help the development team to avoid game design elements which restrict access, are incongruent to behaviour change or are unappealing to the target audience, reducing uptake and use of the game [95,96]. Methods to facilitate communication of ideas and preferences by target users were sourced from games for health studies relating to sexual health, which involved consultation with target users in the design process [97,98]. In these studies, target users took on the role of informant with focus group discussions used to elicit design ideas and user preferences.

While participatory game design may have benefits with regards to the effectiveness of the game the evidence is mixed when reviewed in the context of games for healthy lifestyle promotion. Evaluation of user-involvement as a moderator of game effectiveness has shown heterogeneity in the methods used and the effectiveness of the game [99]. A meta-analysis which explored the association between participatory design (PD) and the effectiveness of games for healthy lifestyle promotion highlighted significant differences in the effectiveness of games developed with PD, and more support for user-centred design methods i.e., users as informants and prototype testers [99]. Overall PD was associated with lower effectiveness. The authors theorised that the surprising result was potentially due to the varied ways in which end users were engaged in the design process and their level of expertise. They hypothesised that informants may have lacked sufficient subject domain or design expertise which resulted in focusing on irrelevant aspects or ideas that conflicted with the pedagogical goals of the game. A second hypothesis related to the PD methods used, suggesting that they may not have been appropriately adjusted to the target users design experience and cognitive abilities. Findings indicate a need to carefully select informants based on their relevant expertise or take the time to create expertise, assess their comprehension of games for HIV-related behaviour change and utilise PD methods which encourage creativity and reflection in pursuit of a shared goal. There is also a need to clearly define the role and contribution of target users

in the design process. If interaction with target users is confined to focus group discussions, then it would be unrealistic to expect them to contribute design solutions.

Suitable games for health mechanics

A common practice in the games for health field is to draw inspiration from the entertainment games industry. While the game mechanics will primarily be guided by principles of pedagogy and behaviour change, entertainment games provide a valuable resource of proven engaging and usable mechanics. Repurposing game mechanics from popular games has the benefit of familiarity, which may reduce the need for player instruction and consequently the cognitive load required to play the game, providing thinking space for the player to reflect on the health messaging in the game. Drawing inspiration from existing games may also enable the use of pre-built game assets which will reduce development time and costs. These insights were drawn from a series of commentary pieces and roundtable discussions with leading experts [78,95,100,101].

Use of narrative elements that allow for control over narrative direction can strengthen the player's understanding of connections between choices and health outcomes, providing a virtual scenario in which players can model health related behaviour and receive immediate feedback on the success or failure of the choices they make [78,100,101]. Further to this is the phenomenon of narrative immersion (also referred to as transportation), a process in which people are transported into the story world and their knowledge and attitudes are changed by the journey. Research has found that the level of narrative immersion is positively related to the persuasiveness of the medium [79]. Unlike other storytelling mediums, such as text or film, interactive narratives in games possess a unique quality in which the player takes an active role in how the story unfolds. The connection between narratives in games, immersion and behaviour change is under-researched [78]. A primary reason for this is the complexity involved in building a true interactive narrative as every possible choice and outcome must be coded; because of this, narratives in games are typically delivered through cinematic cut scenes. When players are given control over narrative direction the choices available to them are often superficial and lead to a limited number of possible plot directions or conclusions. While potentially effective in achieving behaviour change, integration of narrative and gameplay presents a complex challenge for the developers and will be heavily influenced by available time and resources.

Determining whether a game mechanic is appropriate can only be achieved through prototype testing. Prototype testing is a process in which the usability, enjoyment and effect of the game on knowledge and attitudes is assessed[16]. It is therefore important that early builds of the

[16] As Chapter 3 focuses on the initial design of the game, involvement of target users as prototype testers is discussed in Chapter 4 which describes the development process for the game and acceptability study.

game are tested by target users to ensure adequate time and resources are available to change or revise elements of the game if required.

Experts agreed that successful games for health mechanics are those which are grounded in theory while still contributing to the fun and flow of the game. Flow is the concept of maintaining player engagement by increasing challenge in line with the players competence, challenge exceeding competence may lead to frustration and competence exceeding challenge may lead to boredom, both resulting in player drop out [95]. Ultimately there is no right or wrong mechanic to use, developing a game for health is a creative process involving cooperation across disciplines and trial and error. This denotes a need to maintain a close working relationship between the game design, subject matter, context and behaviour change experts to ensure design solutions complement the enjoyment and behavioural effect of the game. Individual roles and responsibilities in the game design and development process must align with the team members expertise and skill set, and a chain of command must be established to ensure disagreements between the different groups can be resolved. For example, clinical experts are ideally placed to ensure health related content is accurate, but conflict can arise between the subject matter experts and the game developers when technical accuracy is counterproductive to the enjoyment or accessibility of the game. Thus, as well as providing oversight on the game development, the producer must also act as a mediator between the different disciplines involved. The geographical separation of the game development team in this study presented an additional challenge in facilitating this working relationship. The working relationship between the different expert groups is an aspect often overlooked in studies on games for health effect, despite a theoretical association with the quality of the game.

3.2 Game Design Process Overview (November 2016 – May 2017)

The process used to translate findings from the formative study into a detailed game design document was divided into four steps (Figure 3-1). The game design process spanned a period of seven months. In month four, the process to build the game began once the learning objectives and game design had been established and agreed upon. The game was built by a UK developer (EM Studios) with technical input from a UK physician and Filipino physician, nurse and virologist. Final design choices were made by the game's co-producers: me; Bobby Farmer the director of EM Studios with over 10 years industry experience based in Scotland; and Dr Emmanuel Baja, a Filipino clinical epidemiologist. A condensed version of this section of the thesis was included in a published article (Appendix 9) [58].

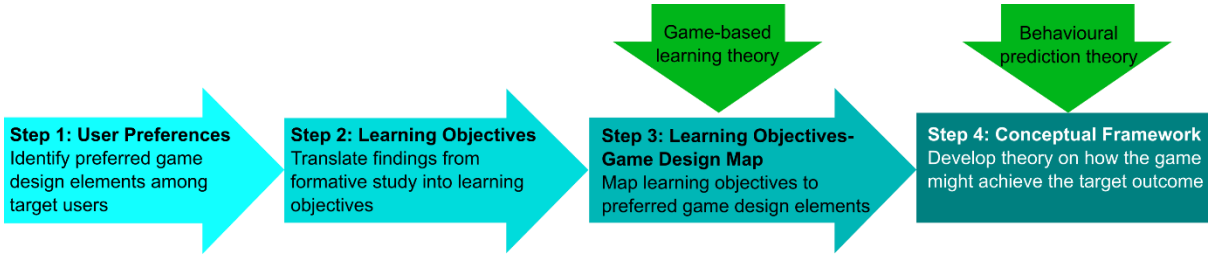


Figure 3-1: Game design process

3.3 Step 1: User Preferences (November 2016 – January 2017)

3.3.1 Methods

To identify important contextual requirements and user preferences, participatory design workshops with Filipino gamers were conducted during the initial specification and ideation stage of the game development.

Recruitment

Filipino individuals aged over 18, residing in the NCR, who regularly played digital games or were involved in game development or e-sports, regardless of sexual identity, were invited to participatory design workshops via social networking sites including Facebook and Steam forums. It was theorised that the game would need to appeal and be accessible to a range of gamer types, and that gamer type would not be dictated by sexual identity. Purposive sampling of participants with experience in the Philippines games industry was used to recruit informants with expertise in game design and technical requirements in the Philippines' context. 18 participants were divided into two groups (11 and 7). Participants were all male aged between 21 and 30 and were a mixed group of MSM and non-MSM.

Data collection

Prior to the design workshop a meeting was held with the facilitators to agree on activities and roles. The facilitator guide for the workshop is presented in appendix 2. I facilitated two group sessions together with Filipino researchers. Workshop activities comprised of (I) participants creating a human scatter graph indicating their level of agreement to different statements by their physical proximity to the statement placed on the floor, creating an instant visual of the group's perception and experience of mobile games and games for health and a group discussion to explain why they had chosen their position of the graph; (II) group discussions on design and technical enablers and barriers to digital gaming; and (III) developing and presenting a pitch for a game to promote HIV services using a white board in teams of 6 and defending their idea. Participants expressed themselves in Filipino and English. HIV counsellors from Klinika Bernardo were present at both workshops to answer any questions the participants had regarding HIV and provided information on HIV service provision in the Philippines. Data collection followed the principle of informed consent. The session was audio

recorded, translated and transcribed. Photos were taken to record the human scatter graphs and visuals from the game pitches.

Analysis

Transcripts and session outputs were analysed using a thematic framework approach [76] to identify a set of recommended game features and user requirements. Transcripts were coded and categorised together with a Filipino research assistant. Findings were written up into a report and reviewed by the game development team. Disagreements were resolved through discussion. Data collected from these sessions was synthesised into a list of desired game features and grouped into the structural components of a game. These were discussed with the game developers at EM studios to identify further design considerations and developer tools which could be taken forward.

3.3.2 Results

Direction on appropriate design features first emerged through the human scatter graph activity. Figure 3-2 demonstrates varied individual perceptions on the effectiveness of mobile games for health-related knowledge and behaviour change, with each circle or square representing and individual.

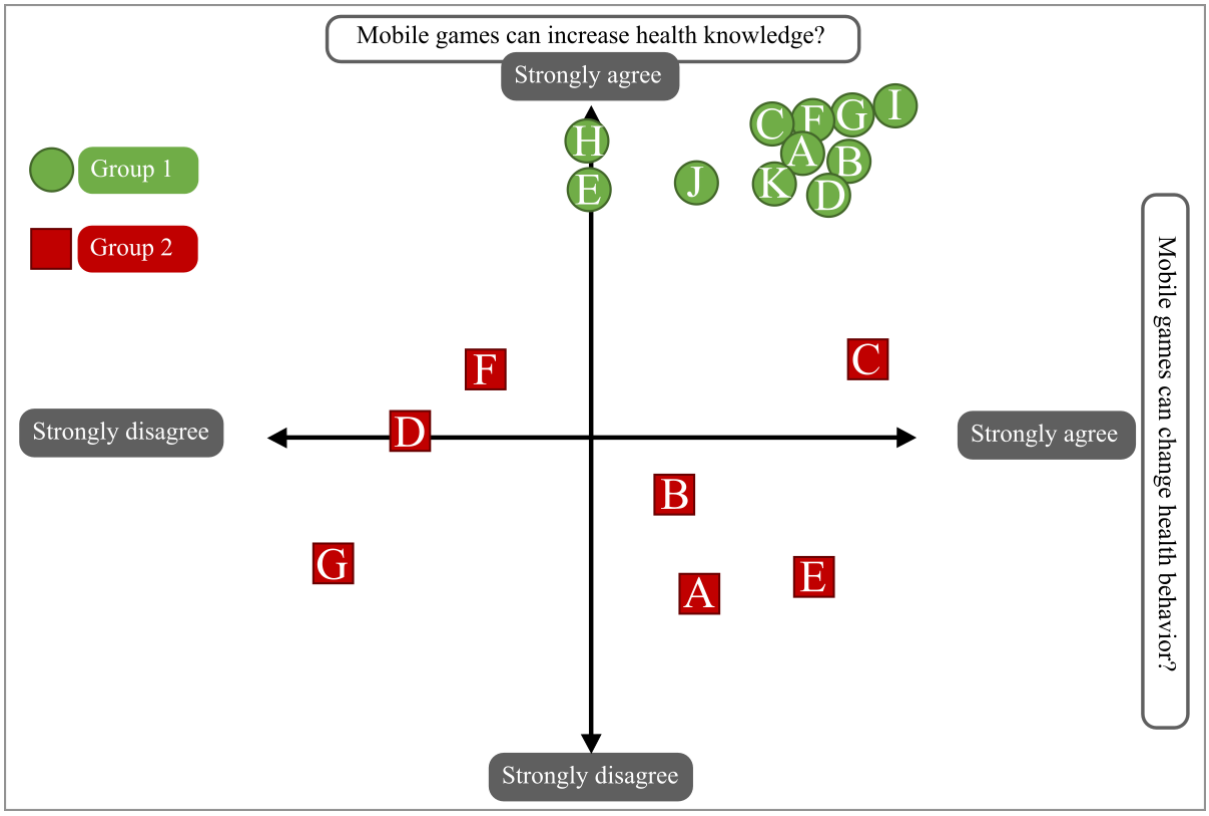


Figure 3-2: Human scatter graph – group perceptions on game effectiveness

In group one there was a clear consensus on the potential of mobile games to influence health-related knowledge and behaviour, demonstrated by the scramble that ensued by eight

participants to stand in the top right-hand corner. Three of the participants showed slight divergence from the group perspective and indicated some uncertainty over the potential of mobile games to influence health related behaviour. Group two showed nonconformity in their response to the question. This demonstrated that not all participants will automatically conform to group ideas and that recruitment of participant who are not necessarily familiar with one another can allow for divergent views to emerge from group discussion.

Prior to this exercise, each participant was asked to talk about their favourite mobile games. Experience and motivation to play mobile games was similar between the two groups. A majority of participants played mobile games because they were accessible e.g., during commutes, and they alleviated boredom or stress. The genre of mobile games they played were also similar, the two commonly cited were action role playing games (RPG) and educational games. This suggests that the divergent group perspectives in the scatter graph activity did not emerge from differing experience of mobile games but rather differing opinions on the personal effect of games in general.

Participants were questioned as to why they had chosen their place on the graph. In group two, perceived limitations of the game's effectiveness were centred around beliefs that changes in knowledge would not be sufficient to change behaviour, and that the use of technical language would make the game's content inaccessible, as illustrated by this quote:

> *"I'm still not convinced with the knowledge part because, as with some health conditions, even with some health benefits and stuff, there will be some things that a player will not understand, especially if it's scientific jargon…but I do believe that behaviour can change especially if it's immersive and it is an experience that will change your perspective on very different matters." -Group 2: Respondent B*

Respondents expanded on this concept by explaining that skills obtained through the games content may not be applicable in real life and would be dependent on conditions in the real world, as illustrated by these quotes:

> *"For me, given a game, maybe it will increase my knowledge and then given the behaviour, maybe if I acquire the knowledge from the game, given a situation, I could apply that certain knowledge that I gain but the thing is given a situation. If there is no situation, no application." – Group 2: Respondent E*

> *"As Respondent B mentioned that even though you don't really apply it, you can't say that your knowledgeable about it, but at least you understand how some people deal with this kind of problem. In that case, let's say you learn about anxiety disorders, and then if you know someone—a friend or someone from the family that has this kind of condition—you learn to put yourself in that kind of situation. It is something that you learn as a surprise on this predicament. At least you're more equipped but you're not ready to actually help the person." – Group 2: Respondent A*

Group one spoke more about facilitators to behaviour change, which centred around the use of immersive experiences that could change perspectives and generate social interactions between users:

> *"Because whenever I'm playing games, they would often ask me 'Hi [name]! What's that game? Is that available in iOS? Is it available in the Android Play Store?' Right after I told them about it, they would go check out the game and download it. So, it's not just me but also them that learns from the game." - Group 1: Respondent J*

The concept that it is not so much the games content but the community which forms around the game that has the greatest impact on behaviour was quite paramount from both groups. Multiplayer gameplay was reported to be a strong motivator for repeated gameplay and was perceived to play a role in the effectiveness of the game:

> *"…they say that no man is an island. So, I think it would affect the behaviour of the person if there is a community that pushes you. Someone playing alone will say 'I'm just alone, nobody will care if I do this or do that.' But if you know somebody else is pushing you, it will affect your behaviour, it drives you as a person." – Group 1: respondent I*

However, participants also reported that access to these types of games was restricted due to the requirement of a stable internet connection:

> *"I have external and internal factors why I leave the game. The external factor is whenever the game requires internet connection because the internet, the wireless data in the Philippines is not that good." Group 1: Respondent E*

This presented a dilemma for the game design. On one hand, multiplayer gameplay was a very desirable game style among the participants as they could participate in discussions about HIV, behaviour and personal values and co-construct their own narratives about a desired future. It was also believed that multiplayer gameplay fostered a stronger gaming community which interacted on a regular basis. On the other hand, we did not have the resources to develop and maintain an online multiplayer platform and known issues around internet connectivity would restrict access to the game.

When the groups were divided into teams (two teams in each group) to pitch their games (participatory method III), three out of the four teams presented a similar concept of a hero sent on a quest to fight or evade the HIV virus, where story and role playing game (RPG) elements intertwined and where reality and fantasy existed in the same space. The human scatter graph activity and group discussion on design and technical enablers and barriers to gaming enabled participants to reflect on their views and the views of others which, in turn, ignited valuable discussion on the qualities the game required to both be accessible and deliver persuasive health messages.

During the game pitches, the game's narrative was identified as an important feature. If done well, it fostered identification with game characters and motivated players to overcome challenges in the gameplay to witness the story unfold. The narrative was identified as the logical place to communicate why it was important to know your HIV status. Participants felt that the game should not provide technical information on HIV or HIV services but should focus on telling an emotionally driven story and provide player choice over the narrative direction:

> *"But on the other hand, what we wanted to do is to give not that much importance on the giving of information. Because we're not in the position to really expound that. Our goal is to motivate them to get tested, and right after arriving in the clinic, that's where they are usually given the detailed information of everything that they should know—of the bigger picture. What they needed to know from us is the essential points only—of why they need to get themselves tested. Not really about the process of testing. I mean, the game should not be responsible to give out super specific details. It's okay to have info dump but it should not be the primary feature of the game, it should be something that is subtle within the game." – Group 2: Respondent G*

Participants also felt the narratives should draw from the lived experiences of Filipinos and include multiple character types to support player empathy.

Recommended game features and user requirements

The group sessions provided direction for the development team on the game genre, narrative and social features. Social features were highlighted as an important factor in the game's potential to influence behaviour which presented a difficult design challenge for the development team as the inclusion of online only gameplay would inevitably restrict access to the game within the Philippines' context. This raised the question on whether the game could include both online and offline gameplay and whether we could connect the game with external social media platforms. It was agreed that additional qualities such as intuitive controls and functional interfaces could be achieved by drawing inspiration from popular games on the app stores. Table 3 presents a complete list of design features extracted from the group sessions and a summary of discussions with the development team.

Table 3: Step 1 game design considerations

Structural Component	Desired Game Feature	Design Considerations and Advice from Game Developers
Gameplay	Role playing game (RPG) - To control the appearance, strength and traits of a central game character	Balancing a game is the process of tuning game rules with the goal of preventing any component being too powerful or weak, rendering the game too easy or hard and making certain strategies or game objects obsolete. The importance of balancing becomes more pronounced in RPGs when the player has control over the characters strength and traits. The developers proposed the following solutions to ensure balancing activities remained feasible within the given resources: • Limit the number of variable considerations for the player unit to reduce complexity and amount of time required to balance the game. • Use Google Sheets as a content management system for the game. In database terms, each sheet on a spreadsheet is essentially a single structured query language (SQL) database. The first row is used for property names and the second row is used to define the property type (string, float, int, bool, enum). Past that is the actual data for the game. For example, this is where you can set the player units health and attack capacity for each level in the game. When a game boots up, it can compare its local version of each content sheet with the server version and download updates as necessary. This provides a valuable mechanism to update a live-operating game or even server different versions of the content to different users. As these changes are made using Google Sheets and doesn't require access to the game engine it allows for all members of the HIV GET Tested team to edit content in the game and take an active role in balancing the game's difficulty.
	Intuitive controls	• Match-3 games are a tried and tested genre in the mobile games market and a significant proportion of mobile gamers will be familiar with the controls. The match-3 game mechanic can be blended with traditional turn-based combat RPG elements, where players manage their resources in combat by matching icons on a puzzle board. Providing intuitive controls while incorporating other desired game features. • Pre-built match-3 templates and assets can be used to reduce the development time required to build this aspect of the game.
Feedback and reward	Bitesize gameplay – where players can play for a few minutes at a time and feel they have progressed	• Include linear level progression; where initial levels can be passed with ease and later levels provide challenge to ensure level completion continues to feel rewarding. • Limit the number of available moves, so that players deploying strategic thinking are rewarded and the time required to complete a level remains short.

		• Inclusion of additional challenge modes, such as time challenge levels, to create better gameplay variety was believed to have no direct benefit to the educational component of the game and therefore not a priority.
Conflict, challenge and competition	No in-app purchases that provides unfair advantage to other players	• As there were no plans to generate revenue from the game all content could be made freely available to the end user.
Social features	Cooperative gameplay – perceived to provide benefit to the games appeal and persuasiveness of the health messages	• Limit social aspects in the game due to known issues around internet connectivity in the Philippines, and limited resources to maintain and police the online community of players. • Integrate links to established social media platforms - during this time the Facebook page for the HIV GET Tested project had over 1000 followers and was being maintained by Filipino research assistants. The page was used to promote research activities, share HIV information/ news and respond to any concerns or questions by Facebook users. The game developers confirmed that links to this online community could be integrated into the games content.
Narrative	To play the hero	For this we discussed the idea of the game's protagonist representing HIV treatment and tasking the player with fighting anthropomorphic viruses, bacteria and cancer cells using a weaponised mech suit.
	To be transparent with the HIV content but not too overt; to avoid technical language and detail	It was agreed that it would be difficult to determine if language in the game was appropriate until extensive user testing had been conducted; too overt and the tone of the game is perceived as off-putting or condescending; too obscure and the health messages may not be clear. As a starting rule we agreed to avoid displaying potentially stigmatising terms in large font or in the title of the game. Further to this we agreed to include links to external website containing detailed information on HIV and HIV services in the games content and focus narrative elements on social and emotional factors of HIV testing.
	Driven by player choice	Narratives require structure with believable character interactions and predetermined cause and effect sequences. The developers advised that the only way to maintain narrative structure is to remove or severely limit the player's ability to affect the sequence of events. It was agreed that any narrative choice given to the player must feel like it has genuine consequence especially if the intended purpose is to communicate the positive outcomes of a particular behaviour. Therefore, resources devoted to creating interactive narrative elements in the game were focused on communicating the importance of timely HIV diagnosis.
	Tell the story through visuals with minimal text	Given the requirement for the game to have a small file size the game developers advised using a dynamic 2D manga comic book style for the narrative elements in the game. The games narrative could be delivered in a series of short comic book stories interspersed with the gameplay levels. Dialog in these animations could also be managed through Google Sheets again allowing the full HIV

		GET Tested team to edit a live-operating game. Development of narrative elements would begin on paper using storyboards. These could then be reviewed by target users to refine the story, characters, dialog and visuals before building the animations in the Unity game engine.
	Characters which players can empathise with	For this we discussed the idea of telling a series of short stories each representing a different situation and character type. It was also noted that plot lines could be inspired by narrative experiences from the qualitative study with MSM and TGW (Chapter 2).
Mobility	Small file size suited to typical data plans and the internal storage space of popular devices in the Philippines	A target file size of 70MB was set for the game. The game developers noted a number of techniques within the Unity game engine that can be deployed to reduce the file size without significantly impacting the quality of the graphics, animations and sound.
	Offline gameplay	It was agreed that the game would be playable offline and that the only features that would require an internet connection would be a leader board and links to external web pages.
	Navigation that enhances the game environment and is functional on small screens	The game developers advised using a scrolling map with interactive buttons to navigate levels and an expandable sub-menu with icons. Inspired by games such as Candy-Crush as a tried and tested interface structure. It was noted that use of icons for menu items optimises the screen space but can create usability issues as you are dependent on the user's interpretation.

3.4 Step 2: Learning Objectives (February 2017)

Steps 2 and 3 were completed during a 4-day workshop in the UK with the HIV GET Tested team (Figure 1-7). The first two days were assigned to step 2 and involved the clinical, context and behavioural experts in the team. To establish the learning objectives for the game, discussions were framed using the Force Field Analysis approach. Force Field Analysis is a change management technique based on the works of psychologist Kurt Lewin [102]. According to Lewin, changes in patterned behaviour takes place when an imbalance occurs between the sum of the forces against change (restraining forces) and the sum of the forces for change (driving forces) (Figure 3-3). The model provides a straightforward means of forming a shared understanding of a change problem and enables the group to collaboratively develop ideas using available evidence to reach the desired state.

Figure 3-3: Kurt Lewin's Force Field Analysis

Key enablers and barriers to timely HIV service uptake identified from the literature and formative study (Chapter 2) were presented as either a driving or restraining force. From there discussions were held with the clinical, context and behavioural experts in the team to develop the learning objectives for the game aimed at strengthening driving forces and/or weakening restraining forces. Guided by findings from the formative research, learning objectives focused on communicating the benefits of timely HIV diagnosis in relation to quality of life and strengthening treatment as a counter force to the perceived negative outcomes. Peer support to undergo a HIV test was assumed to be a factor that couldn't be learned through the game but could be a consequence of social interactions triggered by playing the game. Figure 3-4 presents the output of this activity. The learning objectives are presented in the body text.

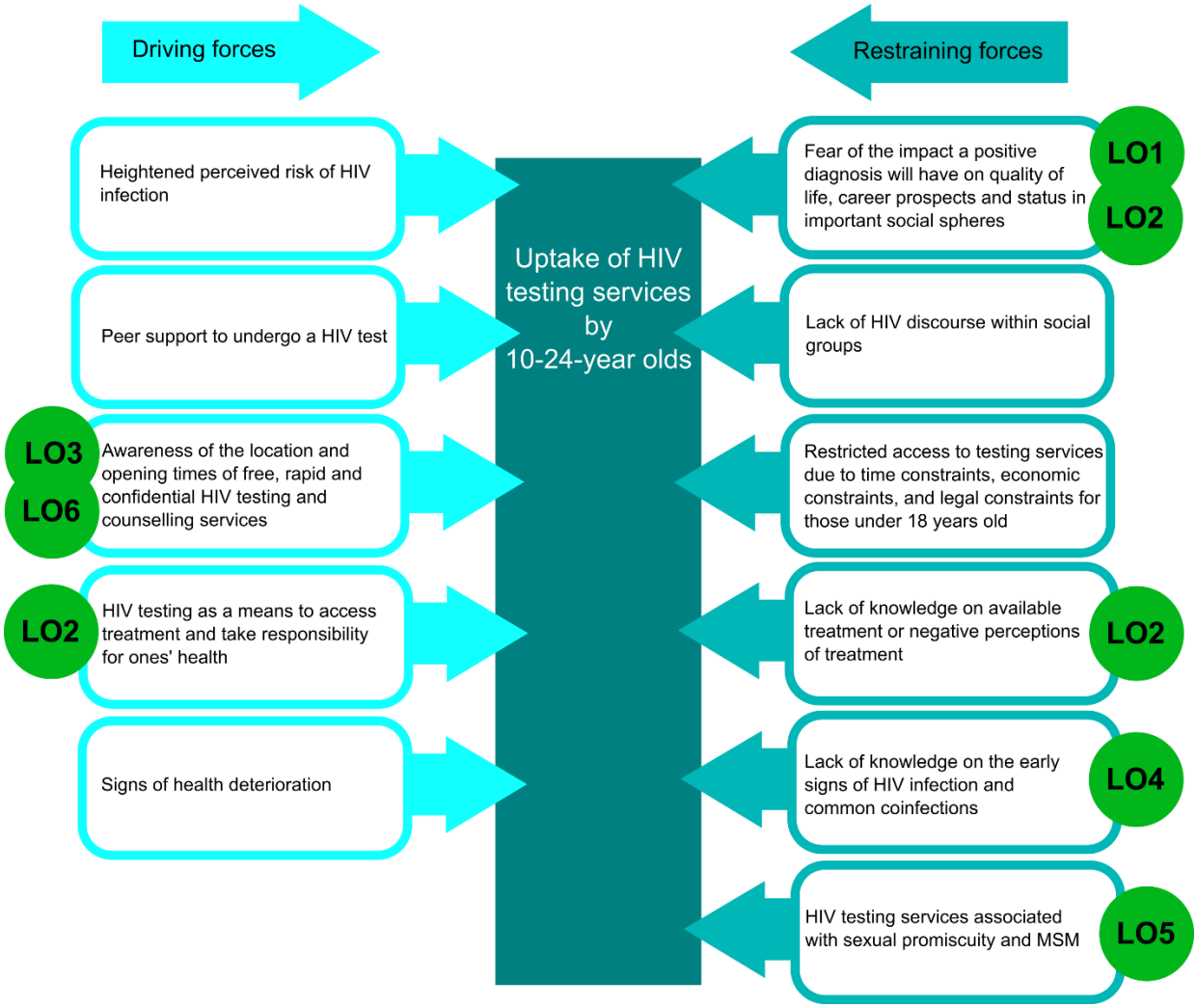


Figure 3-4: Output from force field analysis activity

LO1: To believe you can live a fulfilling life after a positive diagnosis.

LO2: To know HIV treatment makes your immune system stronger and able to fight of illness, reduces the risk of transmitting the virus to someone else and if accessed early can reduce the impact of HIV on the quality/ longevity of life.

LO3: To know HIV testing and treatment services are available for free in the Philippines and results are given on the same day.

LO4: To recognise common coinfections and signs of HIV infection and to know that symptoms may not appear until long after infection.

LO5: To know there is risk of HIV transmission among heterosexuals.

LO6: To know the location and opening times of HIV services.

3.5 Step 3: The Learning Objectives-Game Design Map (February 2017)

Once we had established an initial set of learning objectives for the game, we utilised the Learning Mechanics-Game Mechanics (LM-GM) model to underpin the development of a learning objectives-game design map. The LM-GM model functions as a tool for developers,

providing guidance for designing content [83]. The model provides a set of pre-defined game mechanics and pedagogical elements (Figure 3-5) to support developers in mapping out the relationship between the learning objectives and game design elements. While mechanics on the right align with those on the left the model is not meant to be taken as prescriptive; for example, learning through identification in a game does not have to be done through a question and answer mechanic but this mechanic is appropriate for this type of learning.

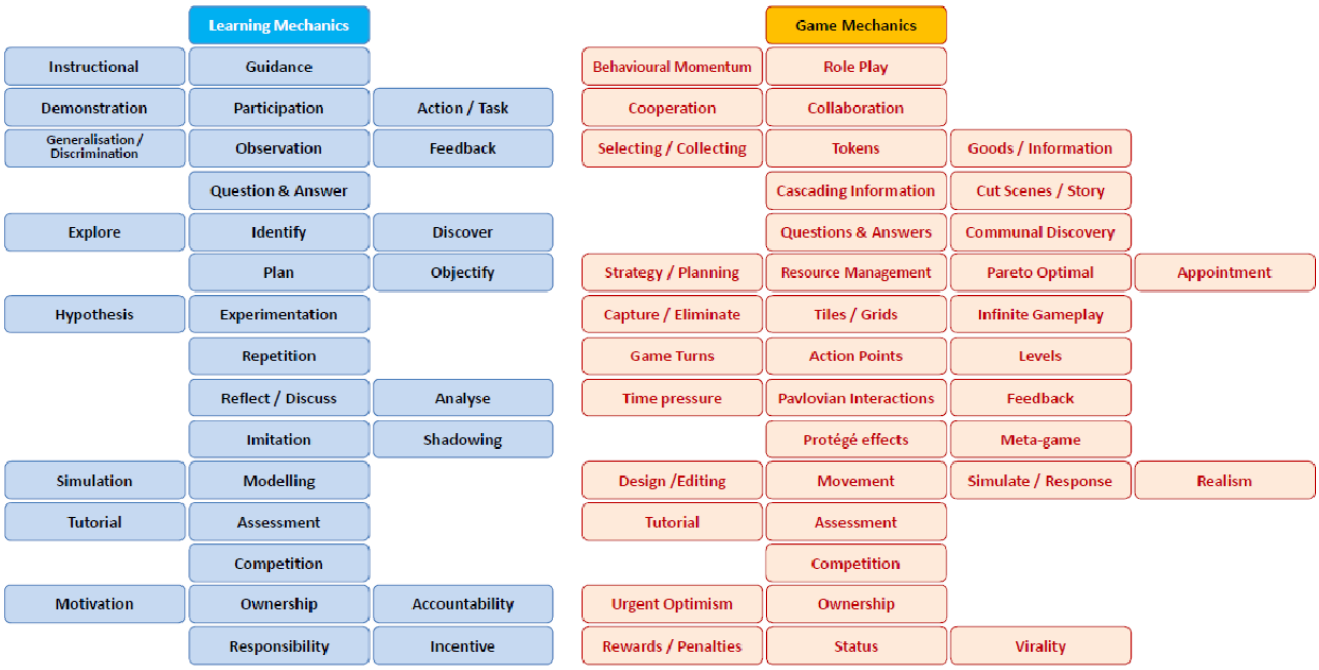


Figure 3-5: Learning and game mechanics used as the basis to construct the LM-GM map for a game

The learning objectives-game design map was co-created by the HIV GET Tested team including the developers at EM Studios. This ensured design solutions were guided by the different disciplines and expertise present in the team.

By this stage of the design process we were working with an initial concept and vision of the game which had been established during step 1. Outputs from step 1 of the design process directed the HIV GET Tested team to a blended match-3 combat RPG game that combined intuitive game controls with narrative elements (see Table 3). In step 3 we fleshed out the initial concept to ensure each learning objective identified in step 2 was addressed in the games content using the learning objectives-game design map which is presented in table 4.

Table 4: Learning objective- game design map

Learning objective	Learning mechanic	Game mechanic	Game design feature
LO1: To believe you can live a fulfilling life after a positive diagnosis.	Discover, reflect/discuss	Cut scenes/ story	Animated stories depict people living with HIV pursuing their ambitions, being socially active or spending time with their family/ friends. Scenarios included: • Entering a beauty pageant – chosen due to the cultural relevance pageantry has in the Philippines and the great esteem in which Filipinos hold contestants. • Visiting the mall with their family – a popular past time for urban Filipinos. • Receiving praise by their employer for a job well done after taking time away from work to take care of their health. • Going to the gym. • Socialising with friends.
LO2: To know HIV treatment makes your immune system stronger and able to fight of illness, reduce the risk of transmitting the virus to someone else, and if accessed early can reduce the impact of HIV on the quality/ longevity of life.	Repetition, reflect/ discuss, discover, feedback	Action points, levels, status, cut scenes/story, questions and answers	Players take on the role of the protagonist, entering the blood stream in an anti-retroviral (ARV) pill capsule and battling anthropomorphic viruses, bacteria and cancer cells using a weaponised mech-suit. The gameplay combines match-3 puzzles with turn-based combat; players connect icons on a puzzle board that represent condoms, ARVs, healthy living, healthcare and time. Connecting the icons builds up the player's defence and attack status during the rounds of combat. The gameplay is segmented with a series of 8 animated stories about people living with HIV that the player helps by progressing through the game. The difficulty of the levels is connected with the story line. For example, if the character in the storyline waits years before diagnosis the enemy units in the level become harder to defeat. In the game's final mission, the player is introduced to a character with advanced disease in a critical condition; it is revealed that he has never been tested for HIV, treatment fails and the character dies. Throughout the game, the player is awarded with fragments which combine to form an anting-anting, a traditional Filipino amulet believed to have magical powers. This amulet allows the player to travel back in time and change how the story ends for this character by encouraging him to undergo a HIV test. ARV tablets feature in every animated story except the one where the character dies. Treatment is also shown to improve the physical appearance of characters in the later missions.

			Players can earn an extra life during gameplay by answering a multiple-choice question. Some questions address knowledge on treatment effects and feedback containing the right answer is given. Hyperlinks to websites containing information on HIV treatment are included throughout the game and the click-through rate is measured.
LO3: To know HIV testing and treatment services are available for free in the Philippines and results are given on the same day.	Instructional, guidance	Cut scenes/ story, questions and answers	In the animated stories, the words 'Free HIV tests' appear in the background of all of the clinic waiting room scenes. The rapid testing procedure is depicted in the first 3 animations. Multiple-choice questions address the availability of free testing and the time taken to results in the Philippines. Hyperlinks to websites containing information on HIV services in the Philippines are included throughout the game and the click-through rate is measured.
LO4: To recognise common coinfections and signs of HIV infection and to know that symptoms may not appear until long after infection.	Discover	Action points, levels, cut scenes/ story	The types of enemy units in the gameplay levels relate to the story line. For example, if the character in the storyline is diagnosed with gonorrhoea, an enemy unit representing gonococcus appears during the gameplay. Enemy units in the game include representations of gonorrhoea, tuberculosis, hepatitis B, herpes and cancer. Common signs of HIV infection are depicted in the animated stories and some characters in the earlier missions show no physical symptoms.
LO5: To know there is risk of HIV transmission among heterosexuals.	Discover, reflect/ discuss	Cut scenes/ story	The first animated story depicts a heterosexual couple. In several other animated stories, the character's sexuality is ambiguous.
LO6: To know the location and opening times of HIV services.	Instructional, guidance	Questions and answers	A hyperlink to a website containing the contact information and location of all testing sites in the Philippines is featured throughout the game and the click-through rate is measured. The player can earn an extra life during gameplay by answering the question 'In the near future, are you planning on getting tested for HIV?' if the player answers yes or maybe they are presented with the hyperlink.

I produced a game design document (GDD) together with Bobby Farmer incorporating outputs from the 4-day workshop. The GDD was reviewed by the full HIV GET Tested team. In the weeks following the workshop the GDD was expanded in collaboration with the developers at EM Studios to provide detail on the back-end analytics, technical requirements and development plan. The GDD functioned as a living document, providing a blueprint for those responsible for building the game. Real time collaboration on the GDD and version control was managed through Google Docs. The final version of the GDD is available on request but has not been included in the appendices as it repeats much of what is presented in the thesis.

3.6 Step 4: Conceptual Framework (February – May 2017)

Unlike the previous steps, development of the conceptual framework was primarily conducted as an independent desk-based exercise with documentation shared with the HIV GET Tested team for review.

Behavioural Prediction Theory

I began by identifying an appropriate theory of behaviour change to act as a foundation. Review of literature on cognitive behavioural theory, presented in section 3.1.1, prompted the use of an integrative approach. I therefore proceeded with Fishbein's Integrative Model of Behaviour Prediction conceived in 2008 to act as a foundation for the conceptual framework [90].

The first step in adapting the model to develop the conceptual framework for the game was to clearly define the targeted behavioural intention and behaviour. Behavioural intention was defined as a willingness to undergo a HIV test in the near future. Using a three-component view of behaviour as an *action* directed at a *target,* performed in a certain *context*, the targeted behaviour was defined as undergoing HIV testing and counselling from a legitimate provider when the individual perceives they are at risk of HIV, with timely linkage to care if reactive.

I then proceeded with the assumption that the game would directly influence the second variable group in the Integrative Model of Behaviour Prediction through the learning objectives. Constructs within the model aligned well with the learning objectives (on the left-hand side of Figure 3-6 in green). For example, to believe that you can still live a fulfilling life after a positive diagnosis aligns with the construct of self-discrepancy. Self-discrepancy is the concept that people will conduct certain behaviours in order to achieve their desired self and that their desired self is influenced by their social environment. The journey between childhood and adulthood is paved with quests to find identity and community and overwhelming pressure from important social spheres, making self-discrepancy a potentially stronger predictor of behaviour change among adolescents compared to outcome expectancies.

Based on the conceptual framework the games content directly affects salient beliefs through the learning objectives which in turn influences attitudes, perceived norm, self-efficacy and

intentions; however, the ability for the user to act on those intentions would still remain dependent on external conditions which the game may have no influence. I therefore expanded the model to include constructs of health system, legal and economic constraints (on the right hand side of Figure 3-6 in blue) given their relevance to uptake of services in the Philippines context. While we did not expect, nor intend for, the game to influence these modifying factors they were likely to impact the games effectiveness in achieving the behavioural objective. Therefore, evaluation of the game's effect had to be viewed in light of structural determinants of behaviour to understand the games limitations in the Philippines context.

Lastly, I included potential game influence on the constructs social pressure and emotional reaction on the assumption that interaction with the game may invoke certain social behaviours or emotional responses which may in turn influence behavioural intention.

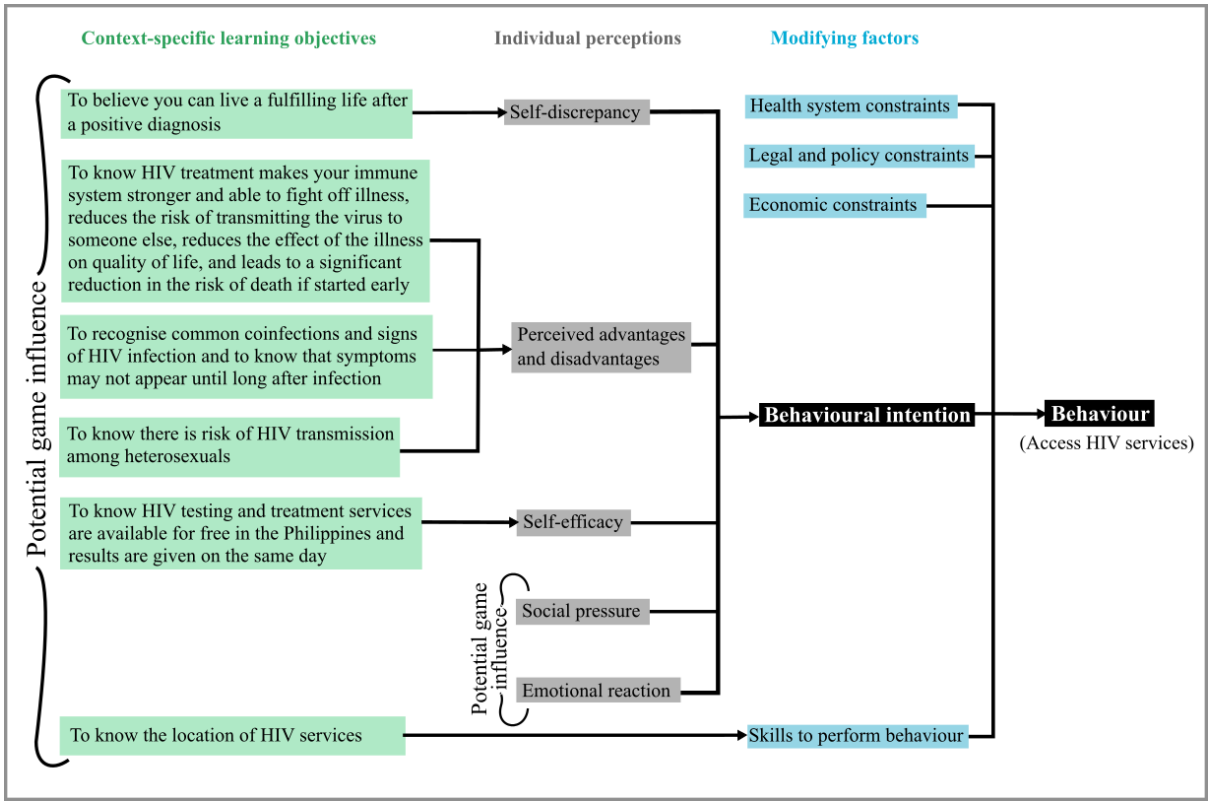


Figure 3-6: Conceptual framework for game effect

The conceptual framework underpinned evaluation of game acceptability and impact on target users.

Chapter 4: Game Development and Uptake

The previous chapter described the process used to translate findings from the formative study into a game design document and conceptual framework to guide evaluation. This chapter describes the development process for the game and how early findings about acceptability fed into the iterative process of improving the game. It describes how game users were at the heart of this process (objective 2 & 3). The chapter concludes with trends associated with HIV testing post-game launch and discusses the implication of findings obtained throughout the development and launch of the game.

4.1 Introduction

Rittel and Webber (1973) defined the term 'wicked problem' as a design problem that cannot be solved in a step-wise problem-solving manner [103]. Game development is riddled with wicked problems. They are inherently interactive, and any interactive component must be tested with users. Even a simple game has an interconnected system as its backbone; any change to one component of the game will have ramifications to all connected components. Furthermore, game development is bound by countless budget, technical, user and market constraints. As a solution to wicked problems, some game developers turned to user-centred design [104]. User-centred design is an iterative process; using a range of research techniques, feedback is obtained from users at different stages of product development to ensure the game is playable and their needs and preferences are considered in the design [105]. This design approach was established in the software industry to identify and rectify usability issues and expanded for use in games to evaluate experiential aspects, supporting the development of games that are both functional and fun.

The core principle behind the need for user-centred design in games for health is that for a game to be effective it must be acceptable to the target user. This can only be achieved through consultation with target users, especially if the developers do not share the same characteristics as them. User involvement is also predicted to improve adoption and enable developers to critically reflect on the value and consequences of a game when vulnerable groups are involved [106]. Thus, user-centred design methods must encompass interpretation and emotional response to health-related content in the game as well as evaluating usability.

Chapter 3 focused on the first stage of a user-centred design approach in which the game design was established through consultation with target users and Philippines' game industry experts. This chapter focuses on the next stage of user centred design, commonly referred to as playtesting in the entertainment games industry [107]. Playtesting uses a set of methods to measure and analyse player behaviour and emotive response during gameplay. This typically involves the collection of both qualitative and quantitative data at different stages of the

development process. Information retrieved is used by the developer to improve player experience, but in games for health development, playtesting methods can also be used to improve the effectiveness of the game in relation to its pedagogical and behavioural goals. In order to do this, playtesting methods must expand beyond facilitated gameplay sessions to explore use and impact of the game within its real-life context, especially when the boundaries between the games impact and the context of game use are not clear.

4.2 Prototype Testing (August – November 2017)

Several rounds of prototype testing were conducted. Early sessions consisted of FGDs with target users in the Philippines to obtain feedback on paper-based prototypes of the animated narratives and interface design, enabling the team to identify and rectify design flaws at minimal cost. This section describes in detail the later stage prototype testing sessions using a beta game build, in other words, a near to complete product. Prototype testing sessions for the beta game build consisted of a set of playtesting methods; observations of target users playing the game, a pre- and post-gameplay survey on knowledge and perceived stigma in relation to HIV, and FGDs on the narratives and health content. Game changes and bug fixes were implemented between each playtesting session.

4.2.1 Methods

Recruitment

Purposive sampling was used to recruit participants from the game target population group who were between the ages of 18-30-years old, who self-identified as MSM or TGW[17] and were not known to be HIV positive. This differed from the recruitment approach deployed in step 1 of the design process (section 3.3) as our aim was to ensure the narratives and art style were appealing, relatable and inoffensive to MSM and TGW in the Philippines. Participants were recruited using social networking sites including Facebook, Grindr, Growler and Planet Romeo, known as popular networking sites for the MSM and TGW community. Additional recruitment was conducted through DOTA 2 Steam forums, DOTA 2 being a very popular mass multiplayer online game in the Philippines and Steam providing a social media platform for DOTA 2 players to communicate. Peer counsellors were recruited from Davao Reproductive Health and Wellness Centre (DRHWC) as they were believed to be an important user group for the game who could bring a different perspective.

Data Collection

The first two prototype testing sessions in August and September 2017 involved the following activities: (I) participants' screens and faces were video recorded as they played the game for 30-45 minutes (Figure 4-1), screens were captured using iOS inbuilt screen recording feature

[17] Several TGW responded to the recruitment ads and were invited to participate but did not attend the sessions. Failure to recruit TGW is addressed in the limitations section of this chapter.

for Apple devices and AZ Recorder for Android; (II) all animations in the game were played on a big screen and a short discussion was held by participants for each one; and (III) a group discussion on the perceived acceptability of the game. The three sessions in November 2017 involved the activities stated above and a pre- and post-gameplay knowledge and attitude assessment. Knowledge questions were developed through consultation with the HIV GET Tested team and informed by the game's learning objectives. Attitude questions were developed through adaptation of a 12-item version of the HIV stigma scale [108]. The HIV stigma scale is designed to be conducted on PLHIV to measure personal experiences of stigma, as we would be recruiting participants who were not part of this population, wording of the 12-items was adjusted to elicit views on perceived stigma facing PLHIV. The survey was printed and completed by the participants under exam conditions i.e., no coffering with other participants or use of mobile devices. The pre-survey was completed before activity I and the post survey completed after activity III. Participants did not discuss their responses to the survey questions. The survey tool is presented in appendix 3. The survey was added to the prototype testing sessions to provide a quantitative measure of knowledge and attitude change to supplement the qualitative findings.

Data collection methods were piloted in the UK to explore the feasibility and quality of feedback obtained from individual versus group observations. The pros and cons of each method were discussed and summarised in Table 5.

Table 5: Decision process for individual vs group observation

	Individual	**Group**
Description	One participant and one facilitator in a private room. One camera is focused on the participant's face and AZ Recorder is used to record the screen. The participant is encouraged to continuously talk about what they are doing, thinking and feeling (think aloud technique). The facilitator asks probing questions.	Four participants and one facilitator in a private room. One camera is used with all four participants in frame. Facilitator observes the participants screen and takes notes. The facilitator asks probing questions to encourage discussion and thought sharing among the participants.
Pros	• Provides lots of material for reflection and in-depth analysis. • No risk of the participant being influenced by other members of the group. • No risk of dominant personalities leading the discussion. • Facilitator is not overstretched and can observe everything the player does.	• Less resources and time required. • Information obtained was similar to the individual method. • Appeared to be an enjoyable experience for the participants as they talked about the game amongst themselves.

Cons	• Heavy dependence on hardware and time wasted addressing technical issues with the camera and screen capture technology. • Uses a lot of resources. Both costly and time consuming. • Given the game has a very simple interface and the game levels are very similar this depth of usability testing may not be required. Participant was observed repeating the same thought processes providing no new information on the playability of the game after the first 10 levels. • The participant appeared visibly uncomfortable under close observation.	• At times a participant will know how to proceed in the game not by figuring it out but by watching someone else or asking the group. • Dominant personalities are more likely to answer questions posed by the facilitator. • Facilitator is overstretched as it is not possible to watch four screens at once, take notes and ask questions. Although this limitation could be addressed in part through screen capture technology.

Based on this experience we proceeded with group observations with a minimum ratio of one facilitator to two participants and included screen recordings. Hardware and software were tested prior to each session.

Figure 4-1: Prototype testing set up Philippines

A detailed facilitators guide for the prototype testing session was developed and is presented in appendix 4. Probing questions during gameplay (activity I) were used to; ascertain if the players understood how to play the game, explore how they felt about features in the game and explain choices made during gameplay. Questions during activities II and III focused on

interpretation of the in-game narrative, motivation to play the game and the perceived effect of the game on knowledge and attitudes. Focus on knowledge and attitudes, as opposed to perceived effect of the game of behaviour, was guided by the conceptual framework for the game. In other words, if during prototype testing the game was found to have no effect, or a negative effect, on knowledge and attitudes I would assume it would not have the intended effect on behaviour, and therefore resources could be redirected to re-developing the game before further evaluation was undertaken. Discussions were predominantly facilitated by Filipino researchers to allow the participants to express themselves in Tagalog although some questions and responses were given in English. Video recordings were transcribed and translated into English for analysis.

Analysis

Analysis of data from the prototype testing sessions was divided into two parts. Group observations and discussions were analysed using playability heuristics to identify and fix design flaws. Playability heuristics are a set of qualities by which a game's engagement and usability can be assessed. They are typically used by game developers and professional game testers. An existing list of playability heuristics for mobile games was adapted [109] to use as a coding framework to analyse the video recordings and transcripts (Figure 4-2). Two further playability heuristics under mobility (M05 and M06) were added given concerns over the sensitive content contained in the game and restricted internet access in the Philippines.

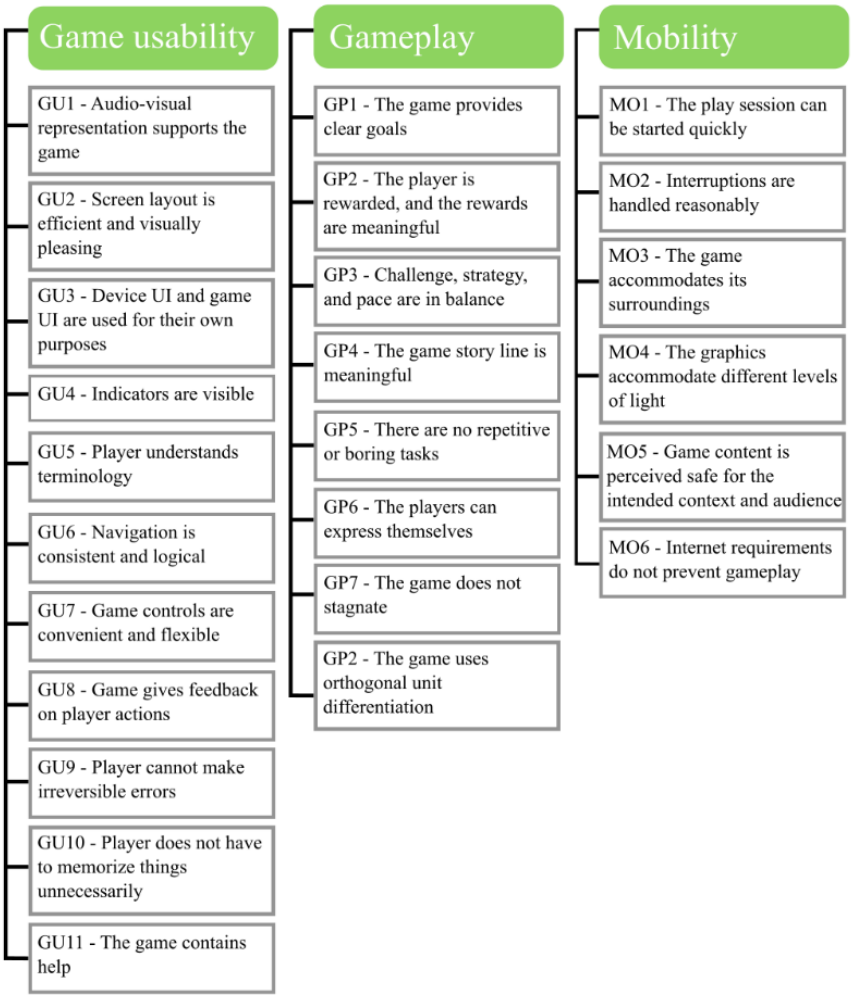


Figure 4-2: Playability heuristics

Screen and face recordings were primarily used to identify technical and usability issues, while transcripts were more conducive to recognising experiential aspects. For example, expressions of confusion by the player when they lost a level, especially when followed by repeated failed attempts, could be marked as a violation of gameplay heuristic GP1, “the game provides clear goals” (Figure 4-2). This is an example of what is termed a playability violation. I and a Filipino research assistant independently developed playability reports from each session. The reports described each playability violation and gave recommendations for game improvements. An example report is presented in appendix 5. The reports were compared and discussed by the game development team before agreeing on a final list of game changes. Where feasible, changes were implemented before the next prototype testing session. Software bugs and technical issues were also recorded, and fixes implemented.

The second part of the data analysis utilised the transcripts to assess the acceptability of the game as a health intervention and its potential to increase knowledge and change attitudes. Descriptive coding was conducted by three members of the HIV GET Tested team using three transcripts. Codes derived directly from the text were discussed to support the development of a coding framework where codes were grouped into categories. Using the coding

framework, I coded the remaining transcripts and interpreted the data. A deductive approach was taken, aligning emerging themes identified in the transcripts with pre-determined constructs of health intervention acceptability; affective attitude, burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness and self-efficacy [110]. Qualitative findings were supplemented with descriptive statistical analysis of the knowledge and attitude survey responses to show the direction of group change in reported knowledge and perceptions of stigma faced by PLHIV.

Beta Game Build Description

The beta game build contained 90 levels of combined match-3 turn-based combat puzzles. Google Sheets acted as the content management system for the game, enabling members of the HIV GET Team to alter text and the difficulty of each level throughout prototype testing. Level 1 included a brief instruction to the player to demonstrate how to connect icons on the puzzle board. No further onboarding was provided.

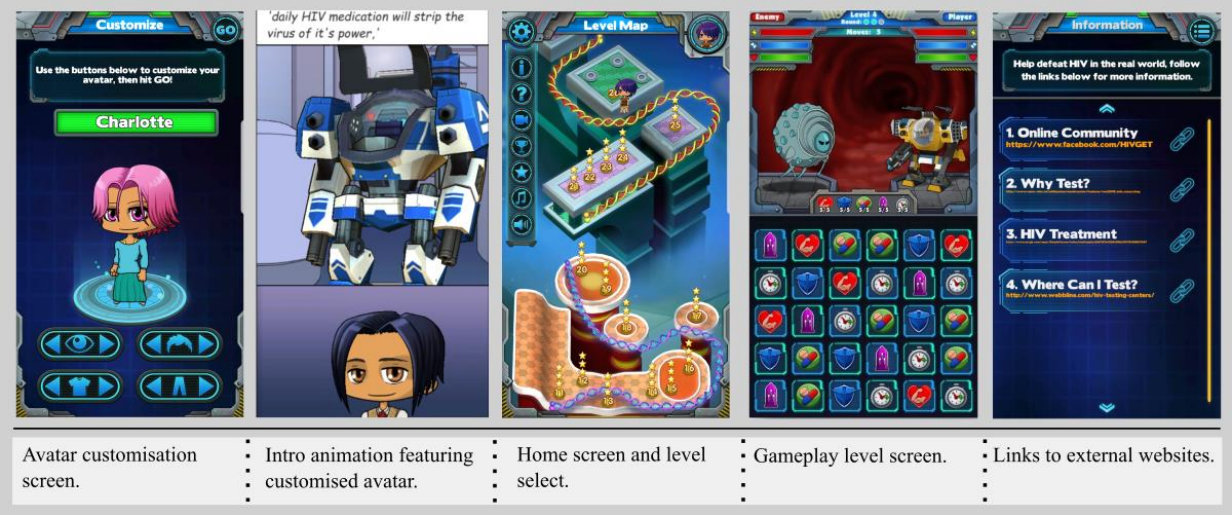


Figure 4-3: Beta game screen grabs

The player begins the game by customising the appearance of their avatar. Their customised avatar then features in the opening animation, entering the blood stream in an anti-retroviral (ARV) pill capsule in a weaponised mech-suit (Figure 4-3). The gameplay is segmented with a series of 8 animated stories played in two parts about people living with HIV. The animated stories are played every 10 levels and feature the players customised avatar. For example, part one of the first animated story plays just before level 1, part two plays after completing level 10. Figure 4-4 displays each scene from the 7th animation which features between levels 70 to 80. The character from the game's final story can be seen in the background of the 3rd to last scene. Levels 70 to 80 in the game feature both the HIV and tuberculosis (TB) enemy units. Figure 4-5 displays the enemy units in the game.

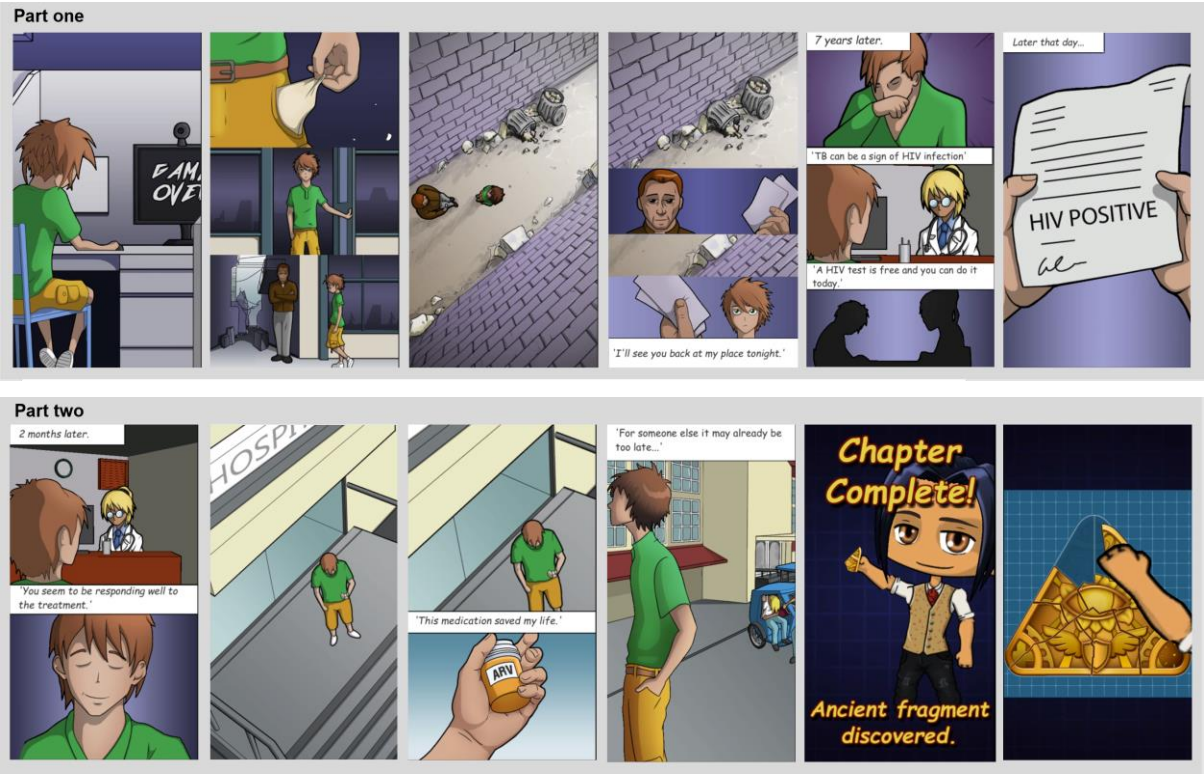


Figure 4-4: In-game animation

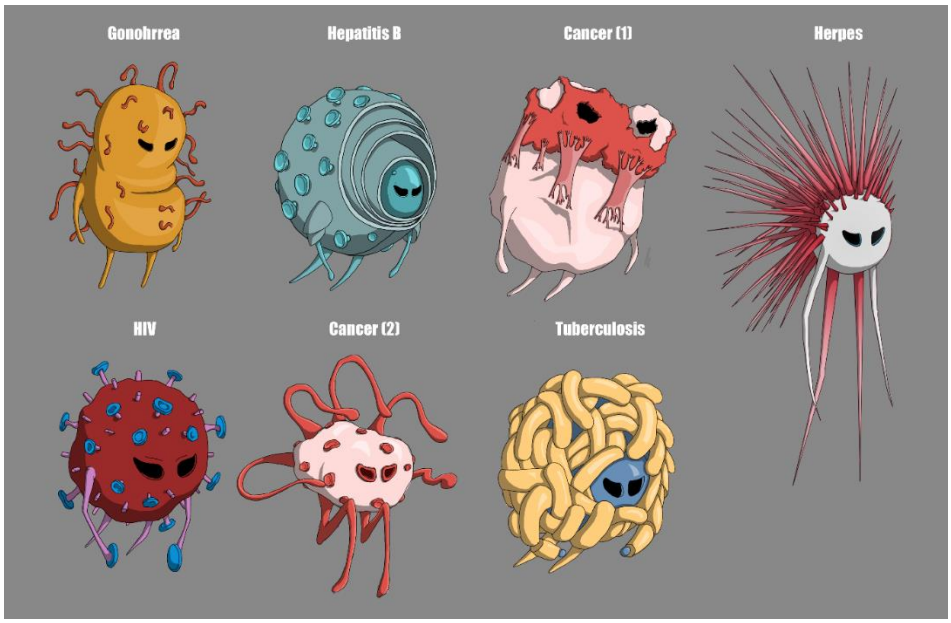


Figure 4-5: Enemy units in the game

The beta game build included a functioning leader board and links to external websites (Figure 4-3). Optional demographic questions asking the players age range, gender and sexuality was triggered after completing level 6. Demographic question appeared at this point as it was believed that most users would reach this level, any earlier than this level and the questions may have disrupted the crucial first five minutes of gameplay leading to high player drop out. Knowledge and attitude-based questions appeared randomly when the player failed a level.

By answering the question, the player is awarded with a second chance to beat the level. In-game questions that featured in the game are presented in Table 6.

Table 6: In-game questions

Question	Response options	Response feedback
1. What is your age?	Less than 10 10-14 15-19 20-24 25-34 35 or more Don't want to disclose	N/A
2. You are?	Male Female Transgender (male to female) Transgender (female to male) Genderless Don't want to disclose	N/A
3. Who have you had sex with?	Male only Female only Males and females I have not had sex Don't want to disclose	N/A
4. How would you describe your sexuality?	Heterosexual Homosexual Bisexual Pansexual Not sure None of the above Don't want to disclose	N/A
5. HIV can only be transmitted by gay men?	True False Not sure	True - Incorrect. Both women and men can transmit HIV. False - Correct! Both women and men can transmit HIV. Not sure – The answer is false. Both women and men can transmit HIV.
6. If you should get a negative HIV test result while engaging in unprotected sex, when should you test again?	The next day In 6 weeks In 10 months Not sure	The next day or in 10 months - Incorrect. Consult your doctor or local sexual health clinic for more information on the window period. In 6 weeks - Correct! Consult your doctor or local sexual health clinic for more information on the window period.

		Not sure – The answer is 6 weeks. Consult your doctor or local sexual health clinic for more information on the window period.
7. In the near future, are you planning to get tested for HIV?	Yes No Maybe	Yes or Maybe - You can visit the link below to see testing locations near you. http://www.webbline.com/hiv-testing-centers/
8. If I tested positive for HIV, my friends and family would support me.	Yes No Maybe	N/A
9. Undetectable viral load equals?	Unknown Untransmittable Undeniable	Unknown or Undeniable - Incorrect. Undetectable = Untransmittable. Search #UequalsU for more info. Untransmittable - Correct! Undetectable = Untransmittable. Search #UequalsU for more info.
10. Employers have the right to ask you, or your healthcare provider, for your HIV status?	True False Not sure	True – Incorrect. You do not have to disclose your HIV status. False – Correct! You do not have to disclose your HIV status. Not sure – The answer is false. You do not have to disclose your HIV status.
11. Do you think there is treatment available for HIV?	Yes No Not sure	No – Incorrect. HIV can't be cured but it can be treated with lifelong medication. For more information on ARVs follow the link: https://www.avert.org/living-with-hiv/starting-treatment Yes - Correct! HIV can't be cured but it can be treated with lifelong medication. For more information on ARVs follow the link: https://www.avert.org/living-with-hiv/starting-treatment Not sure – The answer is yes. HIV can't be cured but it can be treated with lifelong medication. For more information on ARVs follow the link: https://www.avert.org/living-with-hiv/starting-treatment

Quality assurance of data interpretation

All qualitative data collected was translated into English for analysis and the translation checked for accuracy by members of the research team. I led the analysis with regular consultation and input from the full project team to improve quality and depth. All game changes resulting from the data were reviewed by the development team before implementation.

4.2.2 Results

Five prototype testing sessions involving a total of 22 participants were conducted between 20/08/2017 and 18/11/2017; four in the NCR (17 participants all MSM) and one in Davao (5 participants all peer counsellors and MSM). A summary of participant characteristic and prototype testing session locations is presented in Table 7.

Table 7: Summary of prototype testing sessions

Session ID	Date	Total number of MSM participants	Age range	Location
01	20/08/2017	5	20-27	National Capital Region
02	09/09/2017	5	19-29	Davao
03	16/11/2017	3	18-24	National Capital Region
04	17/11/2017	2	21-24	National Capital Region
05	18/11/2017	7	18-21	National Capital Region

Table 8 summarises the final agreed list of playability violations, and the game changes made as a result. In addition to these game changes minor edits were made to the 8 animations to improve the delivery of the story and clarity of the message, although none of these edits equated to significant changes in the narrative.

Table 8: Summary of playability violations & game changes

Playability Heuristic	Evidence of Violation	Game Change
GP5 There are no repetitive or boring tasks	Participants felt bored and disengaged with the animation when the first half of the storyline was repeated. Video footage demonstrated that players did not realise they could skip the recap by tapping anywhere on the screen.	On the second playthrough, a title screen appears with the text 'Previously on BitB…Skip?'
GU1 Audio-visual representations support the game	Players reported the icons on the puzzle board as counterintuitive because the colour of the icons did not correspond with the combat status bars that they effected. Video footage showed players taking decisions based solely on the length of the chain, not the colour of the icons, and becoming frustrated when they repeatedly lost a level.	The design of the icons was adjusted to correspond visually with the attack and defence bars. (Figure 4-6)
GU11 The game contains help	Participants did not feel the onboarding was comprehensive enough and new mechanics in the game were not explained. Such as how each icon relates to the attack and status bars.	When a new mechanic is triggered, a dialogue box appears which explains the new mechanic using a small amount of text and images. This information can also be accessed via the game's menu and via the level pause screen. An information page which explains what each of the puzzle board icons represents with links to external website for further information was also added. (Figure 4-7)

GP6 The players can express themselves	Participants stated that they did not like the mech suit as they had spent time customising the avatar but rarely saw it in the game as most of it was covered.	Avatar appears animated in the level complete or fail screen.
GP2 The player is rewarded, and the rewards are meaningful/ GP5 There are no repetitive or boring tasks	Participants stated that they wanted to be able to earn in-game currency through completing the levels, which could be spent on upgrading or customising their character. They also felt this would make the gameplay feel less repetitive.	Implementing an in-game currency system and custom character upgrades would have required additional resources and delayed the planned launch of the game. The change request was logged but not implemented for the pilot.

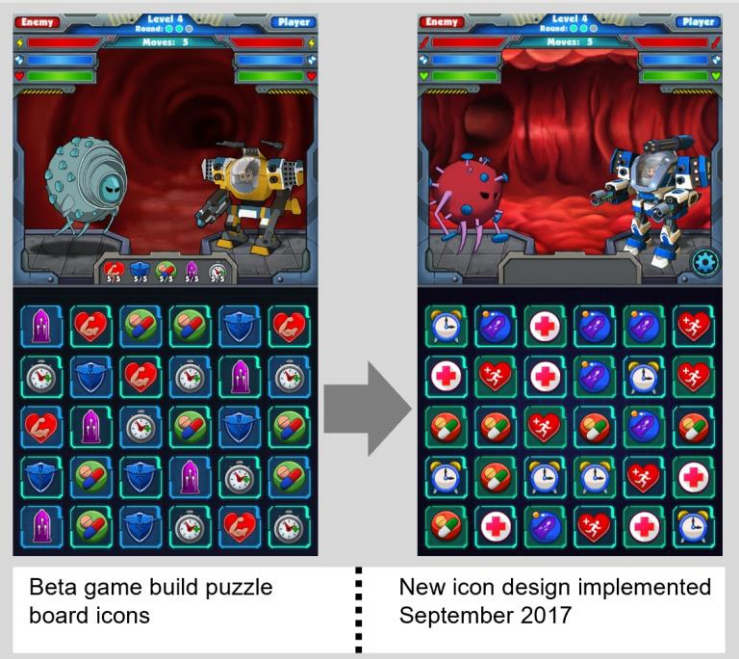


Figure 4-6: Updated icon design

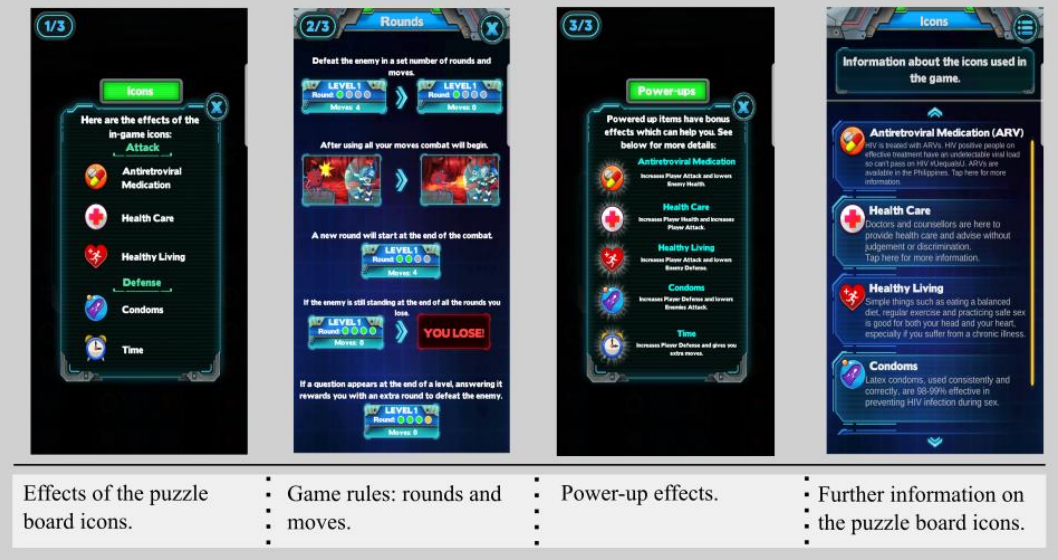


Figure 4-7: Updated in-game onboarding

Learning achieved predominantly through interpretation of the animated narratives

Participants repeatedly drew inferences between the presence of ARVs and the positive outcome in the short-animated stories, recognising the unique benefits of treatment for each character. The illustrative quote below was taken from a participant's interpretation of the second animation in the game:

> *"Ever since the guy was given the ARVs, his fear of him having STDs or socializing with people is now gone, and he was able to not be afraid to connect with other people." –GameTester_MSM*

As well as inferred benefits of HIV treatment, participants also identified messages around the consequences of delayed access to HIV services. One participant reported the game had changed his personal understanding of when to undergo a HIV test, as this conversation shows:

> *"For me it's better to test at the earliest, so you can know if you're positive and prevent it earlier." - Prototype_GameTester_MSM*

> *"So, before you played the game, you just know that you need to get tested when?" - Interviewer*

> *"Only if you're already having symptoms." - Prototype_GameTester_MSM*

Participants interpreted the stories based on their current knowledge and personal values. In one case this led to the message of the story being repeatedly challenged:

> *"…he was told that he has Gonorrhoea and he was then given pills to cure it and the HIV treatment. With that, he told himself that this could save his life and then could continue living his life normally. And then he was seen to be at the bar again. But it was somehow an off for me because it gave me the impression that just because there's treatment, you can go on with your promiscuous activity all your life." - Prototype_GameTester_MSM*

Some counterarguments were expressed due to pre-existing knowledge, namely a lack of awareness that ARVs can reduce the viral load to the point where the individual is no longer infectious, and social norms in which sexual promiscuity is perceived as an undesirable trait. Most participants concluded that the character in this animation was sexually promiscuous because the story centred around a nightclub and he was diagnosed with HIV and gonorrhoea. In this case, the narrative appeared to challenge stigmatising perceptions around sexual promiscuity and its association with HIV.

While participants felt the health-related messages were reinforced in the turn-based combat levels, most of the learning outcomes were achieved through interpretation of the animated narratives and the discussions they triggered. A potential concern is that the animations were perceived to be disconnected from, and less engaging than, the gameplay. During the prototype testing session, all in-game animations were played in sequence through a projector and participants intently watched and discussed each animation. Interpretation of the narrative

may be significantly different by a user casually playing the game alone with no direct incentive to focus on and discuss the content.

Identification with game characters

Animated narratives where the players shared a set of commonalities with the character diagnosed with HIV elicited a stronger emotional reaction than those where characters did not share similar demographics or behaviours. The story of a young MSM, who resorts to solicitation in order to play games at an internet café, was reported to be the most impactful storyline by almost all game testers (Figure 4-4). This story was inspired by anecdotal evidence of young males soliciting themselves to fund their online gaming habit obtained prior to the start of the study. Most participants were part of the young MSM community and had a strong interest in gaming and therefore could relate to this story through personal experience:

> *"Well it seems relatable for me because I'm a gamer. And I have a friend who does that thing [solicitation] sometimes. And thankfully he hasn't got any HIV. It's relatable to me because well, I know those who did, I experienced one but thankfully I haven't got HIV." - GameTester_MSM*

The game follows the stories of 8 different characters diagnosed with HIV. Each character is unique in their sexuality, gender, appearance and behaviour. Therefore, a user is likely to empathise with or relate to some, but not all, characters in the game. As game characters are presented in a pre-determined sequence, some users may never witness a character that they share commonalities with, reducing the potential impact of the in-game narrative for certain users based on their progress in the game. The representation of different sexualities and genders was well-received by the MSM participants as they acknowledged that it could help to address misconceptions that HIV only effects MSM, indicating that the design flaw was the delivery of the narratives rather than the inclusion of multiple character types.

Gameplay perceived as enjoyable but potentially limited in appeal

Despite a positive response from participants in which gameplay was described as "*enjoyable, addictive and challenging*" there were indications that the gameplay would have limited appeal. In the first instance, participants had very low expectations for the game and expressed surprise at playing a game comparable to commercial games on the app stores. In one prototype testing session, participants identified two categories of gamers, casual and hardcore, and discussed which category the game would appeal to and why. A casual gamer was perceived to be someone who occasionally engaged with digital games as a form of distraction, whereas a hardcore gamer's life would revolve around digital games. Most agreed that the game would have little to no appeal for hardcore gamers. For casual gamers, the consensus was that the game would be appealing but required an effective marketing and deployment strategy to overcome competition from similar games. Offline gameplay was perceived to be a strong motivator, regardless of gamer type, as it would enable players to

alleviate boredom when they were unable to access features on their devices that required an internet connection. Marketing BitB as a game about HIV was perceived to have two effects on the appeal; in most cases it would arouse curiosity or tap into a desire to learn, while in some cases it could be off-putting due to concerns of being seen in public playing a game about HIV. Participants felt that the game's marketing should also be targeted towards parents and should offer information on the age-appropriateness of the content.

Quantitative assessment of knowledge and attitude change

Eleven participants completed the pre- and post-gameplay survey. The age range was 18-24-years-old. Ten of the participants identified as male, one clarified they were born male but identified as non-binary. Most participants had a high school level of education or above; four reported to have finished high school, three completed grade 11, one finished college, one was an undergraduate and two chose not to disclose their education status. Three participants reported having tested for HIV in the last 2-5 years.

The maximum available score in the knowledge survey was 28. Scores from the pre-gameplay survey ranged from 8-24 and 8-25 in the post-gameplay survey. The average increase between pre- and post-knowledge scores was 4.8 (Figure 4-8).

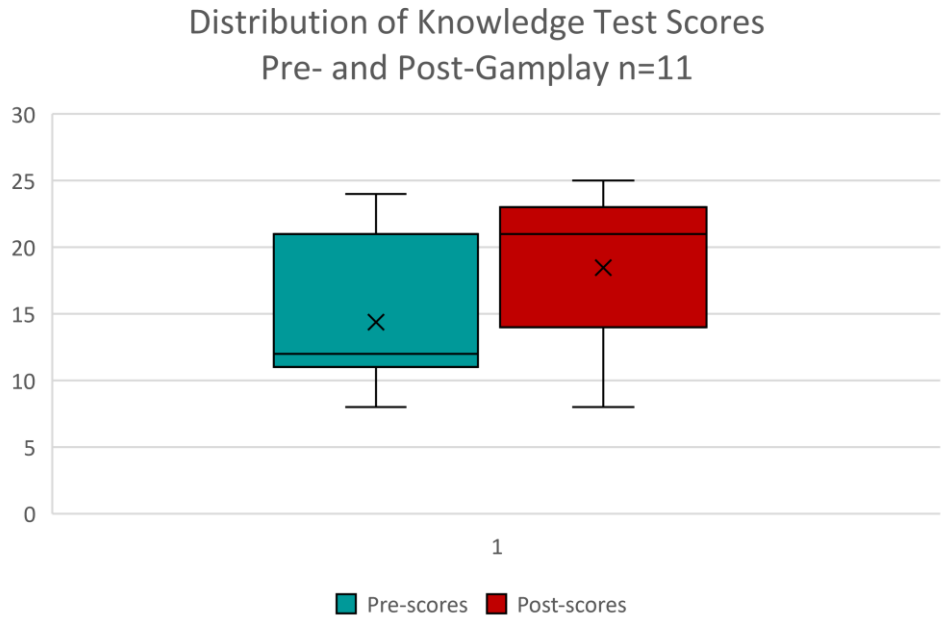


Figure 4-8: Distribution of knowledge scores at the start of end of the prototype testing session – the mean score (x), 1st and 3rd quartiles (box), and range (whiskers) n=11

For participants with a pre-gameplay knowledge score of <14 (i.e., 50% of the maximum available score) representing low starting knowledge, scores ranged from 8-13 from the pre-gameplay survey and 8-23 in the post-gameplay survey (Figure 4-9). The highest increase in score was 14.

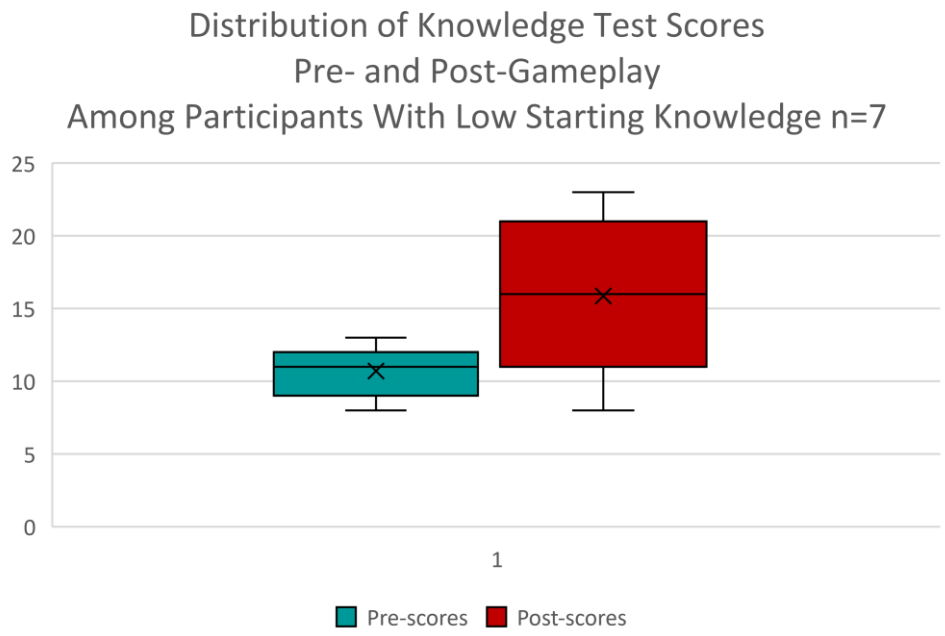


Figure 4-9: Distribution of knowledge scores at the start of end of the prototype testing session – the mean score (x), 1st and 3rd quartiles (box), and range (whiskers) n=7

The maximum available score in the stigma scale was 48, with higher scores reflecting greater perceived stigma. Scores from the pre-gameplay survey ranged from 20-42 and 17-40 in the post-gameplay survey (Figure 4-10). The average decrease in pre- and post-stigma score was 6.3.

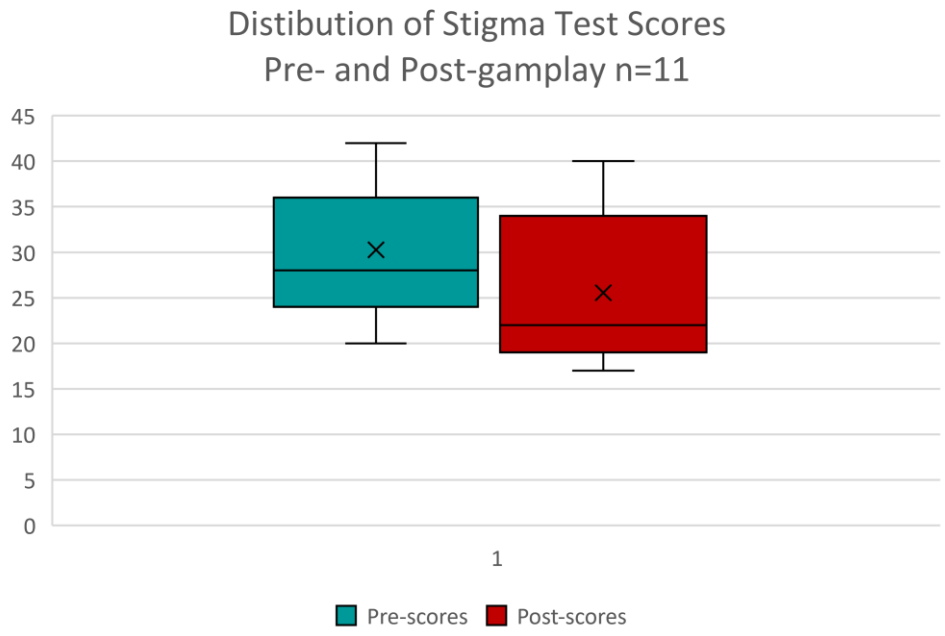


Figure 4-10: Distribution of stigma scores at the start of end of the prototype testing session – the mean score (x), 1st and 3rd quartiles (box), and range (whiskers) n=11

The data did not meet the assumptions for a parametric test; pre-gameplay scores were not normally distributed (Shapiro Wilks Test W=0.85167, p-value = 0.04488) and post scores were positively skewed.

Quantitative assessment of knowledge and attitude change indicate that interaction with the game and participation in discussion around the narratives and acceptability of the game as a health intervention resulted in positive changes in reported knowledge for some but not all participants. The observed reduction in perceived stigma facing PLHIV in the Philippines among all participants indicates that the game could be successful in reducing fear in knowing one's HIV status, identified as a prominent barrier to HIV services during the formative research.

4.3 Game Analytics (December 2017 – December 2018)

Game analytics can be thought of as a quantitative playtesting method on a large scale. Unlike the prototype testing sessions the sample was determined by how many people played the game. Data was collected and interpreted in real time allowing timely improvements to be made to the game to address any playability issues identified through the game analytics.

Data Collection

Data collection and interpretation spanned a 12-month period from 01/12/2017 to 01/12/2018. Event data were automatically gathered from devices with the game installed through the Unity Analytics service v2017.1. As the user plays the game event data is automatically sent to the Unity Data Store where it is processed, provided they are connected to the internet when playing the game. When there is no internet connection during gameplay, event data is stored locally on the device and sent asynchronously when an internet connection is available and the game is launched. A data pipeline was built by EM Studios which exported the raw data from the Unity Analytics service and converted it into a secure readable Excel file. The Excel file contained 6 datasets to track different concepts in the game, each connected by a user identifier (ID) and session ID and is detailed in Table 9.

Table 9: Event data, game analytics

Users dataset		
Field	**Data type**	**Details/ Source**
userid	String	The first time the game is launched a unique ID is randomly generated by Unity Analytics and stored locally on the device. Updates and reinstalls by the same user on the same device do not count as a new user, the only way multiple userids could be generated for one device is if the user deletes the file containing the userid on their device before reinstalling the game
deviceid	String	ID number specific to the user's device, obtained from the device's operating system settings
platform	String	Processed by Unity Analytics using the deviceid - format: AndroidPlayer, iPhonePlayer

version	Float	Game build version number e.g., 1.0.1 taken from the Unity Game Engine - supporting documentation to connect version number with game build description
country	String	Processed by Google Maps Service using longitude and latitude taken from device global positioning system (GPS) - format: Philippines, UK etc.
Sessions dataset		
sessionid	String	Randomly generated by Unity Analytics - a new sessionid and record is generated each time the game is fully closed and reopened
userid	String	As above
ts (time stamp)	Time	Obtained from the device clock at the point when the game is started on the device – format: year-month-date hours:minutes:seconds AM/PM
playtime	Time	Obtained from the device operating system - the duration of time the game is active on the device player - paused when app is minimised/ running in background – format: hours:minutes:seconds
longitude	Decimal	Obtained from the device GPS at the point when the game is started on the device - processed to only show up to 2 decimal places
latitude	Decimal	Obtained from the device GPS at the point when the game is started on the device - processed to only show up to 2 decimal places
version	Float	As above
country	String	As above
Level events dataset		
sessionid	String	As above
userid	String	As above
ts (time stamp)	Time	Obtained from the device clock at the point when the level event was triggered on the device - format: year-month-date hours:minutes:seconds AM/PM
level	Integer	Numeric reference for each level in the game – format: 1-90
result	String	Outcome of the level event – format: Win, Lose, ExtraRoundWin, ExtraRoundLose
stars	Integer	Star rating achieved by the player during the level event - format: 1-3
round	Integer	Each level contains 3-6 rounds, data field reports the round in which the result for the level event was triggered e.g., win in round 2 - format: 1-6
maxRounds	Integer	Maximum number of rounds available in the level - format: 1-6
playerHealth	Float	A numeric value of the playable unit's health at the point the result was triggered during the level event
maxPlayerHealth	Float	A numeric value of the maximum health of the playable unit in each level
enemyHealth/ maxEnemyHealth	Float	Same as above but for the enemy unit
version	Float	As above
Animation events		
sessionid	String	As above
userid	String	As above

ts (time stamp)	Time	Obtained from the device clock at the point when the animation event was triggered on the device - format: year-month-date hours:minutes:seconds AM/PM
section	Integer	Numeric reference for each animation in the game - format: 0-9
time	Time	Duration animation was visible on the device - format: hours:minutes:seconds
skipped	Boolean	Reports if the animation was skipped by the player during the animation event, note that animations can not be skipped on the first playthrough
version	Float	As above
Question events dataset		
sessionid	String	As above
userid	String	As above
ts (time stamp)	Time	Obtained from the device clock at the point when the question event was triggered on the device - format: year-month-date hours:minutes:seconds AM/PM
question	Integer	Numeric reference for each question in the game – format: 0-12
answer	Integer	Numeric reference for the question response – format: 0-7 – only one response per question is permitted, responses cannot be changed after submission – 0 indicates when the question dialog box has been closed and no response given – the same question will keep appearing until a response is given. If a user uninstalls the game, clears any cached data and re-installs the game then they can answer the same question multiple times. In such cases the userid is used to count only the first response given in the analysis. Supporting documentation connects the numeric reference with question and response text.
version	Float	As above
Link events dataset		
sessionid	String	As above
userid	String	As above
ts (time stamp)	Time	Obtained from the device clock at the point when the link event was triggered on the device - format: year-month-date hours:minutes:seconds AM/PM
link	URL	The URL as it appears in the game
clicked	Boolean	If a link is viewed and not clicked it's marked as false, if a link is viewed and clicked it's marked as true

Analysis

Uptake of the game was determined through analysis of the users and sessions datasets. The users dataset was used to track the number of installs in a given day and the sessions dataset was used to track the number of active players in a given day, enabling the HIV GET Tested team to assess the impact of different marketing events for the game. Regional uptake of the game in the Philippines was determined by removing duplicate userids from the sessions dataset, filtering the data to only include longitude and latitude points in the Philippines and

importing the data into QGIS v3.2.3 to conduct spatial analysis. Uptake among target users was determined through analysis of the question event dataset for in-game demographic questions i.e., questions 1-4 in Table 6. Table 10 presents the user categories and how they were determined using responses to the in-game demographic questions.

Table 10: User categories

User Category	Conditions
MSM	Reported gender as male and reported to have had sex with only males or males and females.
TGW who have sex with men (TGWSM)	Reported as transgender (male to female) and reported to have had sex with only males or males and females.
Females who have sex with males (FSM)	Reported gender as female and reported to have had sex with only males.
Males who have sex with females (MSF)	Reported gender as male and reported to have had sex with only females.

Game progression was determined through analysis of the level event dataset e.g., determining how many users had completed each level. Level event data was monitored throughout the 12-month period to identify points in the game where the difficulty needed to be adjusted to ensure early levels were easy to pass and later levels provided challenge.

The game asks the player 'in the near future, are you planning to get tested for HIV?' Question event data was combined with link event data to measure responses to this question and how many users clicked on the weblink to further information on testing services in the Philippines.

Descriptive statistical analysis was conducted in Microsoft Excel v1812.

Playtime data was excluded from the analysis as issues were identified in the accuracy and completeness of the data provided by the Unity Analytics service.

4.3.1 Data Protection Regulation

Event data was obtained from users who installed the game and played the game with the device connected to the internet. Event data was only collected from users who played the game offline if they gave permission for the application to access device storage. This was required to enable event data to be stored locally while the device was not connected to the internet and sent to the server at a later date. Geolocation data was obtained from users who granted access to their devices' location data and played the game with GPS switched on. Longitude and latitude data points were restricted to 2 decimal places when exported from the Unity Analytics service so that the precise location of the user could not be read. It is possible, albeit unlikely in practice, that data collected by the game could be processed in a way that enabled the identification of individual users and therefore met the definition of personal data under the 2018 EU General Data Protection Regulation (GDPR). While individually the pieces of data didn't fall under the scope of personal data, if combined or referenced against other databases, they could narrow down the number of living persons such that someone's identity

could be reasonably established. In most instances, use of game analytics will trigger a need to comply with relevant data protection regulation. This is because standard game metrics, e.g., daily active users, requires the identification of individual users in the data. Any data associated with an ID referring to one individual, even if it is a randomly generated ID, is personal data under GDPR. As a result of this, any game distributed via the Google Play or Apple App Store that uses game analytics will need to present reasonable justification for use of the data and a privacy statement in order to market the game on the store.

To ensure BitB was data protection compliant, information about why data was being gathered, and reassurances that all data would be kept secure and pseudonymised, were presented on the app store page along with a link to a detailed privacy statement hosted on the LSTM website (https://etch.lstmed.ac.uk/privacy-statement-for-battle-in-the-blood-users). Users were given control over the games access to device storage and GPS (Figure 4-11) and were informed through the privacy statement that refusing access would not restrict their ability to use any of the game's features.

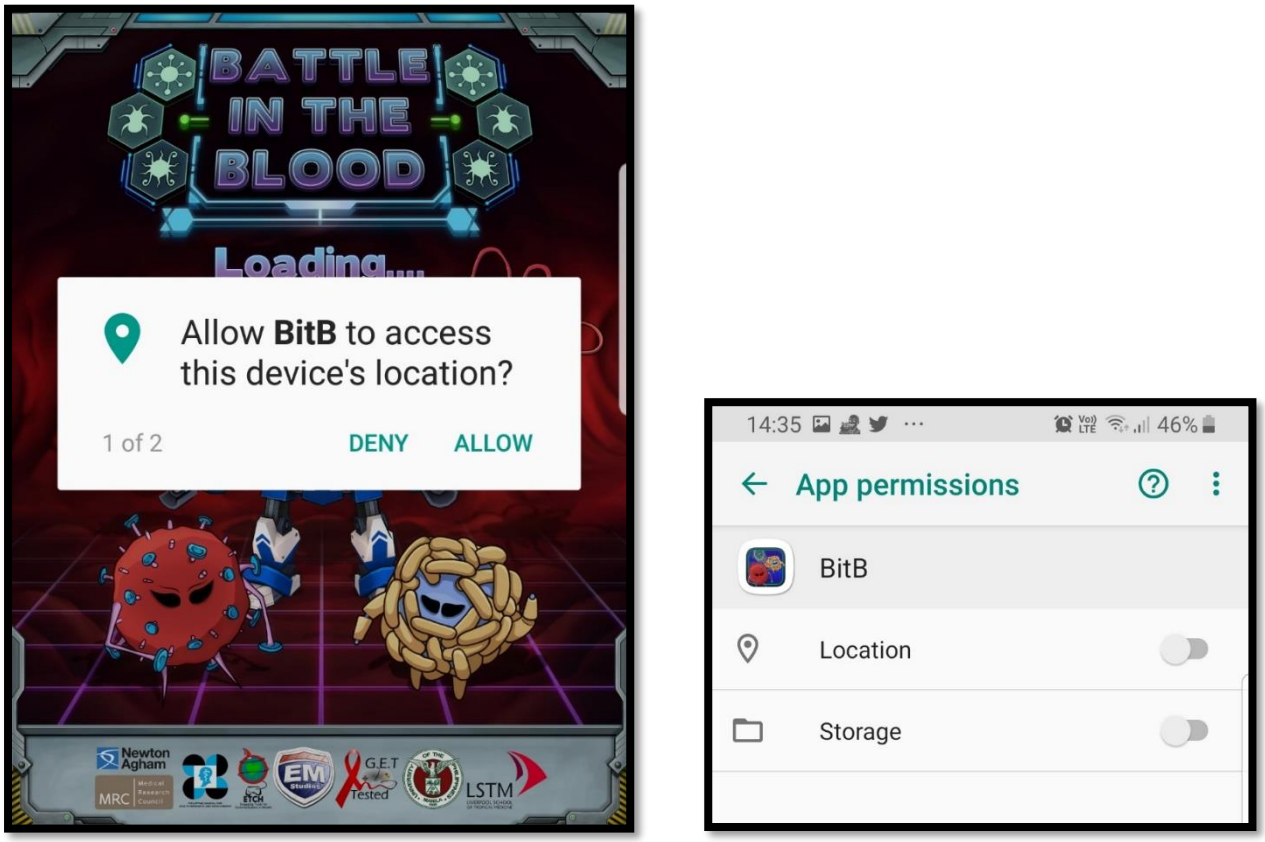


Figure 4-11: BitB Android app permissions, left – in-game app permission, right – device settings app permissions

Legal advice was sought to ensure management of game analytics complied with the 2018 GDPR. The GDPR applied in this case as LSTM and EM Studios, organisations established

in the EU[18], would be processing the data, and the game would be collecting personal information from individuals originating from the EU as it would be made available worldwide. This undoubtedly draws into question why compliance with Philippines' data protection regulation was not sought, and by extension compliance with national data protection regulation from all countries where the game was available. This is because GDPR is considered one of the most comprehensive standards of data protection globally with the strictest requirements [111]. Therefore, by complying with GDPR legal costs are reasonably contained and the risk of being in breach of national data protection regulation is low.

4.3.2 Game launch

The game was made available globally on the Apple App Store and Google Play on the 27/11/2017 and was officially launched during World AIDS Day celebrations in the Davao Region on the 01/12/2017. Marketing events for the game included local television appearances by project staff, printed and online news articles, exhibitions at health and game related conferences in the NCR and Davao Region, social media adverts on Facebook and Twitter, billboards and bus adverts in the NCR and posters displayed in the four study clinics. Description and links to a selection of marketing events are provided in appendix 6.

4.3.3 Results

Game analytics reported 3,325 unique device installs globally during a 12-month period. The game received an average of 10 installs per day. Installs peaked during active and incentivised marketing events; the maximum number of installs in one day was 367 at the time of the World AIDS Day launch event in Davao.

Unity Analytics provided a more accurate report of game uptake and reach than the app store services due to the common practice of using third party apps, such as SHAREit, to access the game via Bluetooth and avoid data costs. Installs via this method would not have been captured by analytical services provided by the Apple App Store or Google Play at the time of the study.

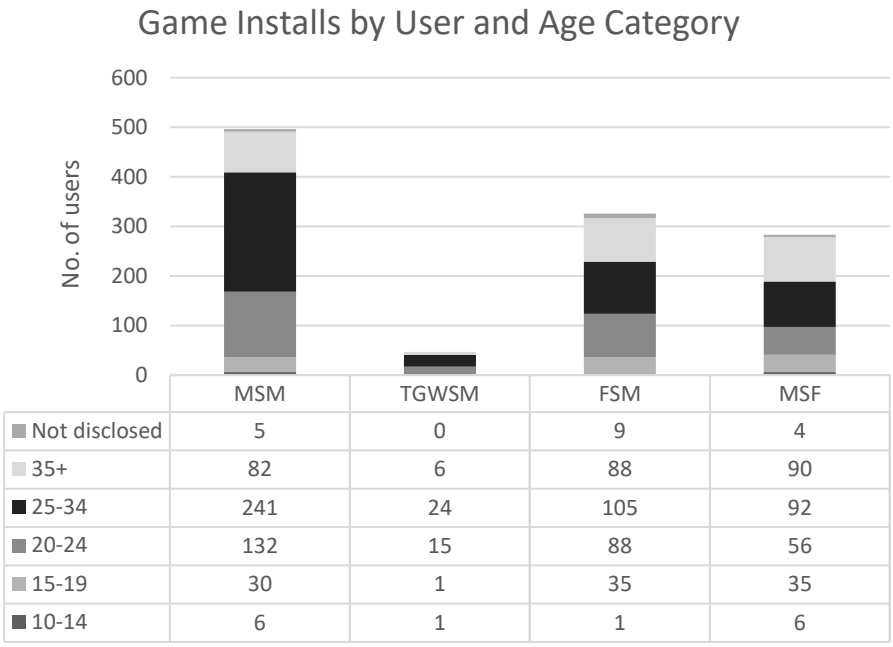
Game analytics and app store reviews were monitored throughout the 12-month period. Monitoring activities supported the identification of an access issue on Android devices, related to app permissions managed by the Google Play store. A fix was launched on 05/11/2018. Between 05/10/2018 and 04/11/2018 the average number of daily active users on Android devices was 16, and this increased to 40 in the month following the fix. The difficulty of some levels was adjusted during the 12-month period based on level event data. These were the only changes made to the game as a result of the game analytics. While the game

[18] It was expected that EU law would still be applicable for organisations in the UK throughout the duration of the study regardless of the Brexit decision.

analytics indicated that more significant changes to the game were needed to improve uptake and player retention, such changes would have incurred additional development costs, for which there was no available funding, whereas addressing software bugs and changing the difficulty of the levels were covered through the service agreement with EM Studios.

Uptake by Target Users

54% (1796/3325) of users reported their age, gender and gender of sexual partners. Reports generated from the game analytics demonstrate uptake of the game among target users i.e., sexually active MSM and TGW, and that MSM were more likely than other categories of users to install the game.



	MSM	TGWSM	FSM	MSF
Not disclosed	5	0	9	4
35+	82	6	88	90
25-34	241	24	105	92
20-24	132	15	88	56
15-19	30	1	35	35
10-14	6	1	1	6

Figure 4-12: Frequency of game users by user category (see table 8) and age group n=1,796

Figure 4-12 indicates the game was less successful at engaging adolescents (10-19 years old) despite predictions that the game would be more appealing to this age group; however, as the data is generated from optional questions completed independently by the user, there was concern that younger users may be less likely to report their true age. This concern was based on the assumption that younger users may feel motivated to report their age above 19 years in a game which contained content on HIV and sexual relationships.

Game Uptake by Region

Geolocation data was collected for at least 1 play session from 50.8% (1688/3325) of users. Of the users from whom geolocation data was collected, 85.4% (1441/1688) were located in the Philippines (Figure 4-13). Game use was concentrated in urbanised areas. Uptake of the game was highest in the NCR and Davao Region as shown by the arrows.

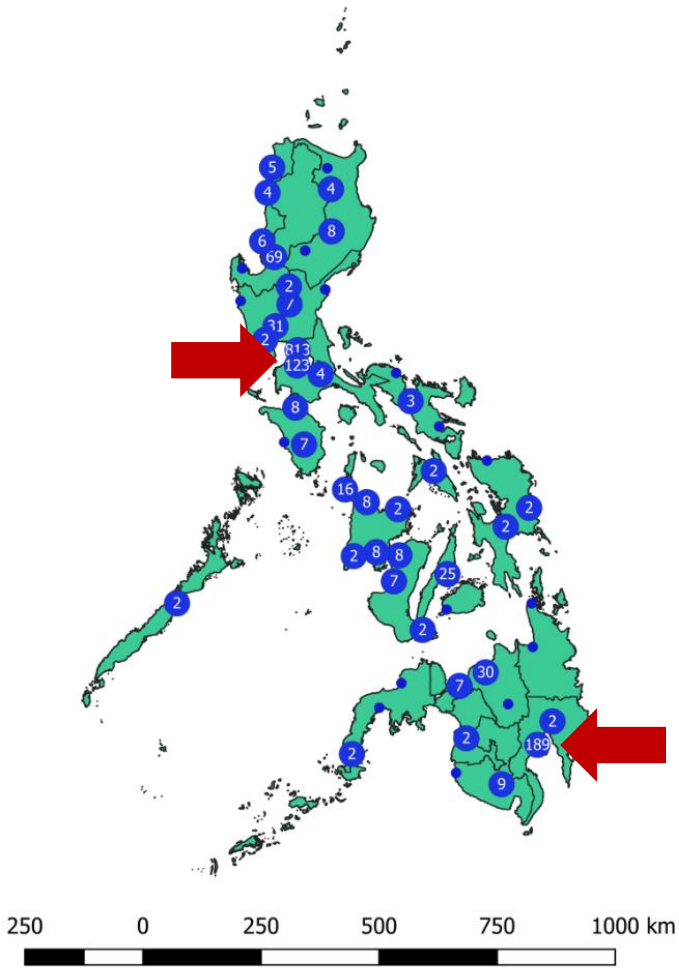


Figure 4-13: Cluster point map of the location of BitB installations in the Philippines. Points clustered at 4mm. Number in circle represents total number of users which installed BitB in that location. Total number of user records from the game analytics that contain geolocation data and have played the game in the Philippines=1441. Region level shape file from Humanitarian Data Exchange.

Beyond the fact that the NCR and Davao Region are densely populated urbanised regions where high uptake was expected there were additional factors that were likely to have contributed to the observed difference between these regions and the rest of the Philippines. First, several promotional exhibitions for the game were held by project staff in these regions. The exhibitions often included prize giveaways for those who downloaded the game, indicating a dependency on these types of active and incentivised marketing events. Question event data indicated that marketing events targeting adolescent users were potentially lacking. Secondly, user-centred design activities were conducted in these regions with influencers in both the gaming and HIV community, and it is likely they also played a role in promoting the game. In addition to this were the study clinics, and it was known that clinic staff were actively promoting the game among clients.

Low Rates of Game Completion

As of 01/12/2018, 15% (498/3325) of users were reported to have completed level 45 and 4% (133/3325) were reported to have completed level 90, the last level in the game. Analysis of combined level and question event data showed no difference in level progression based on the users reported gender, age or user category. While gameplay being perceived as repetitive and having limited appeal were believed to be factors contributing to low rates of game completion, the figures were affected by missing completion data due to offline gameplay. Level event data is only sent if the game is started and the device is connected to the internet, if for example the user only ever plays the game when they are not connected to the internet and then uninstalls the game that data is lost.

Reported Intention to Undergo HIV Testing by Game Users

During the 12-month period 798 users responded to the question 'in the near future, are you planning to get tested for HIV?' 82.5% (658/798) responded yes, 15.5% (124/798) responded maybe and 2.0% (16/798) responded no. Users who responded yes or maybe were presented with a weblink to information on testing services in the Philippines detailing the location and contact details of HIV testing, treatment and counselling sites. Of the 782 users who responded yes or maybe 14.7% (115/782) clicked on the weblink.

4.4 Uptake of HIV Testing Services Post-Game Launch

Prototype testing sessions provided confidence in the game's potential to influence cognitive determinants of HIV service uptake, and the game analytics demonstrated good uptake of the game in the Philippines with the highest uptake in the study clinic regions (NCR and Davao). While these findings support theoretical game effect, they do not provide evidence of game users undergoing HIV testing and counselling from a legitimate provider when the individual perceives they are at risk, with timely linkage to care if reactive. Observed trends in HIV testing service use and interest which correlate with game uptake could be indicative of game effectiveness in relation to its behavioural goals.

4.4.1 Measuring Changes in HIV Service Uptake at the Study Clinics

Methods

Comparison of client registry data in the 11 months pre- and post-game launch (pre-game launch 1st January 2017 – 30th November 2017: post-game launch 1st December 2017 – 31st October 2018) at LoveYourself Anglo, LoveYourself Uni and DRHWC was conducted to assess if there had been any change in HIV testing uptake and the relative frequency of reactive clients by age category. Methods to obtain client registry data from the clinics is described in section 2.3.2. Data collection activities at Kilinka Bernardo ceased in March 2018 after an unexpected loss in funding resulted in Quezon City Council drastically limiting HIV services at the clinic for an extended period which meant the clinic no longer had the capacity

to support the study. Client registry data from Klinka Bernardo was therefore not included in the assessment.

Descriptive analysis was conducted to visualise HIV testing pre- and post-game launch by age category at the three study clinics. An unpaired two tailed t-test was conducted to assess if monthly testing uptake and the number of reactive clients was statistically different pre- and post-game launch by age category. Analysis was conducted in Excel.

Results

Overall testing increased post-game launch at the study clinics in the NCR to a varying degree, at DRHWC overall testing decreased post-game launch. At DRHWC, clinic renovations, detailed in section 1.5.1, was a key factor in the reduced uptake of testing observed in the first quarter of 2017. During this period the clinic was housed in temporary accommodation impacting access to services. Trend analysis of the monthly clinic register data presented in Figure 4-14 suggest that HIV testing uptake remained consistent at the LoveYourself clinics in the NCR. At DRHWC there was a noticeable increase in testing uptake shortly after game launch and the World AIDS Day celebrations taking part in the region, but this increase was not sustained in the months following.

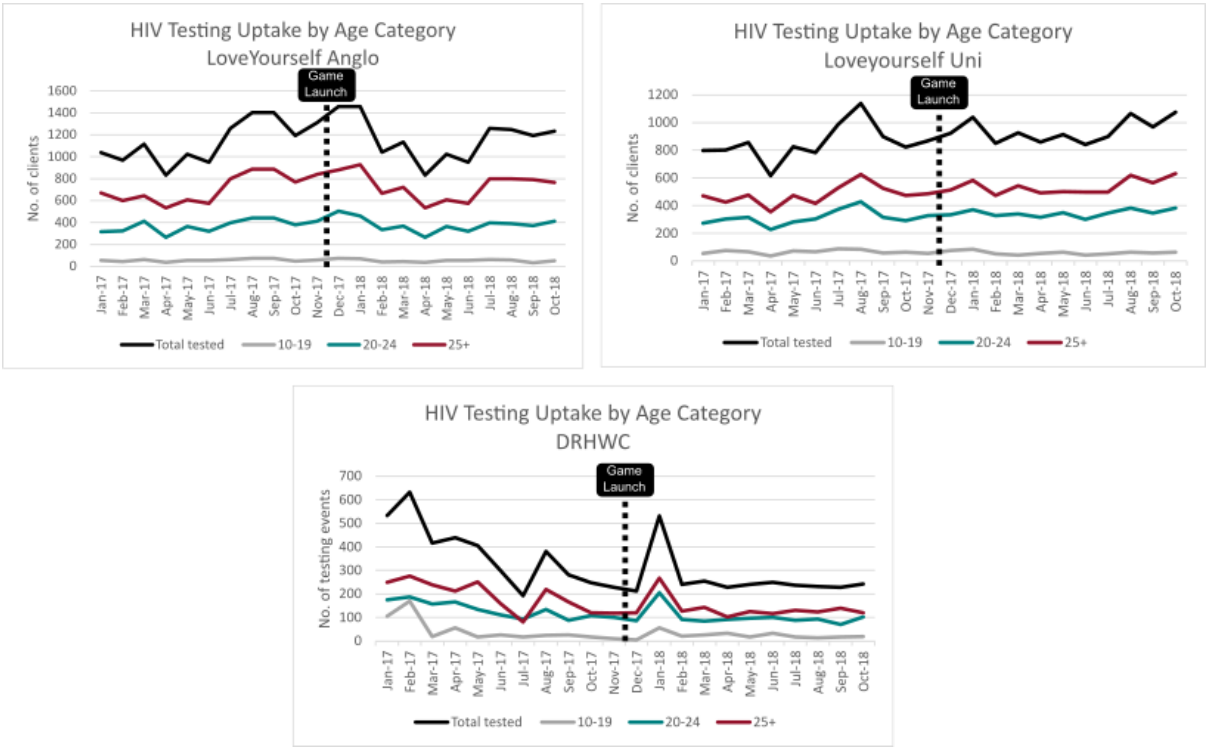


Figure 4-14: HIV testing uptake pre- and post-game launch

Further analysis of the monthly clinic data demonstrates that testing uptake was not statistically different pre- and post-game launch at the LoveYourself clinics in the NCR (Table 11, Table 12); shown in the overlap of the confidence intervals and the results of the unpaired two sample t-test. At .05 alpha, overall testing uptake and testing uptake among 20-24-year-olds was statistically lower post-game launch at DRHWC (Table 13).

Table 11: LoveYourself Anglo monthly testing uptake pre- and post-game launch January 2017 - October 2018

LoveYourself Anglo Total tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	1134.9091	1165.5455
Variance	36645.4909	38525.8727
Observations	11	11
Confidence Interval 95% (upper - lower bound)	128.6045 (1263.51 - 1006.30)	131.8627 (1297.40 - 1033.68)
df	20.0000	
t Stat	-0.3706	
P(T<=t) one-tail	0.3574	
t Critical one-tail	1.7247	
P(T<=t) two-tail	0.7148	
t Critical two-tail	2.0860	
LoveYourself Anglo 10-19 tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	55.6364	52.1818
Variance	131.6545	168.9636
Observations	11	11
Confidence Interval 95% (upper - lower bound)	7.7083 (63.34 - 47.92)	8.7325 (60.91 - 43.44)
df	20.0000	
t Stat	0.6608	
P(T<=t) one-tail	0.2581	
t Critical one-tail	1.7247	
P(T<=t) two-tail	0.5163	
t Critical two-tail	2.0860	
LoveYourself Anglo 20-24 tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	369.9091	380.2727
Variance	3312.6909	4254.4182
Observations	11	11
Confidence Interval 95% (upper - lower bound)	36.6666 (408.57 - 331.24)	43.8193 (424.09 - 336.45)
df	20.0000	
t Stat	-0.3951	
P(T<=t) one-tail	0.3485	
t Critical one-tail	1.7247	
P(T<=t) two-tail	0.6969	
t Critical two-tail	2.0860	

Table 12: LoveYourself Uni monthly testing uptake pre- and post-game launch January 2017 - October 2018

LoveYourself Uni Total tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	854	941.1818
Variance	16928	7093.7636
Observations	11	11
Confidence Interval 95% (upper - lower bound)	87.4075 (941.40 - 766.59)	56.5827 (997.76 - 884.59)
df	17.0000	
t Stat	-1.8656	
P(T<=t) one-tail	0.0397	
t Critical one-tail	1.7396	
P(T<=t) two-tail	0.0794	
t Critical two-tail	2.1098	
LoveYourself Uni 10-19 tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	64.7273	58.8182
Variance	210.8182	170.1636
Observations	11	11
Confidence Interval 95% (upper - lower bound)	9.7543 (74.48 - 54.97)	8.7635 (67.58 - 50.05)
df	20.0000	
t Stat	1.0041	
P(T<=t) one-tail	0.1637	
t Critical one-tail	1.7247	
P(T<=t) two-tail	0.3273	
t Critical two-tail	2.0860	
LoveYourself Uni 20-24 tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	312.2727	344.5455
Variance	2811.8182	671.6727
Observations	11	11
Confidence Interval 95% (upper - lower bound)	35.6237 (347.89 - 276.64)	17.4110 (361.95 - 327.13)
df	15.0000	
t Stat	-1.8135	
P(T<=t) one-tail	0.0449	
t Critical one-tail	1.7531	
P(T<=t) two-tail	0.0898	
t Critical two-tail	2.1314	

Table 13: DRHWC monthly testing uptake pre- and post-game launch January 2017 - October 2018

DRHWC Total tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	368.6364	263.2727
Variance	18322.0545	8019.2182
Observations	11	11
Confidence Interval 95% (upper - lower bound)	90.9354 (459.57 - 277.70)	60.1605 (323.43 - 203.11)
df	17.0000	
t Stat	2.1531	
P(T<=t) one-tail	0.0230	
t Critical one-tail	1.7396	
P(T<=t) two-tail	0.0460	
t Critical two-tail	2.1098	
DRHWC 10-19 tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	44.8182	23.6364
Variance	2441.7636	186.2545
Observations	11	11
Confidence Interval 95% (upper - lower bound)	33.1969 (78.01 - 11.62)	9.1685 (32.80 - 14.46)
df	12.0000	
t Stat	1.3704	
P(T<=t) one-tail	0.0978	
t Critical one-tail	1.7823	
P(T<=t) two-tail	0.1957	
t Critical two-tail	2.1788	
DRHWC 20-24 tested	*Monthly testing uptake pre-game launch*	*Monthly testing uptake post-game launch*
Mean	132.3636	101.0909
Variance	1212.4545	1263.8909
Observations	11	11
Confidence Interval 95% (upper - lower bound)	23.3926 (155.75 - 108.97)	23.8836 (124.97 - 77.20)
df	20.0000	
t Stat	2.0843	
P(T<=t) one-tail	0.0251	
t Critical one-tail	1.7247	
P(T<=t) two-tail	0.0502	
t Critical two-tail	2.0860	

Despite the reduction in testing uptake observed at DRHWC the number of reported reactive test results remained consistent pre- and post-game launch (pre-game launch 253 reactive test results, post-game 233 reactive test results). In conclusion, analysis of client registry data showed very little difference in testing uptake at the study clinics post-game launch.

4.4.2 Measuring Game Use Among Clients at the Study Clinics

Methods

To explore whether the game was a potential factor in observed trends in HIV testing at the study clinics a survey was administered to all clients attending the clinics for HIV testing services in the period 1st December 2017 – 31st October 2018 to record game use [19]. Peer counsellors were instructed to ask clients to complete a paper-based survey after registration while the client waited for pre-test counselling. The survey and participant information sheet were written in English and Tagalog (Appendix 8). Multiple choice questions included whether the client was aware of the game, where they had discovered the game, whether they had played the game and whether it played a role in their attendance at the clinic. Participation in the survey was voluntary. The completed forms were collected by a Filipino research assistant quarterly and entered into Excel. Survey analysis was conducted in Excel.

[19] Ethical approval for the clinic survey was obtained from the University of the Philippines, College of Medicine and LSTM.

Results

The overall response rate to the clinic survey was 13% (3085/23,174) at the LoveYourself clinics[20] and 34% (998/2896) at DRHWC. Table 14 presents a breakdown of the respondent demographics at the LoveYourself clinics and DRHWC and the reported game use by age and gender.

Table 14: Clinic Survey - Respondent demographics and reported game use

DRHWC	n	%	% reported to have played BitB
Age range			
Less than 10	4	0.004	100% (4/4)
10-14	2	0.002	(0/2)
15-19	122	0.12	19% (23/122)
20-24	336	0.33	13% (45/336)
25-34	451	0.45	14% (63/451)
35-49	56	0.05	18% (10/56)
50+	2	0.002	50% (1/2)
Not disclosed	25	0.02	4% (1/25)
Gender			
Male	743	0.74	15% (114/743)
Female	173	0.17	5% (10/173)
Transgender (male to female)	54	0.05	35% (19/54)
Transgender (female to male)	2	0.002	100% (2/2)
Not disclosed	23	0.02	8% (2/23)
LoveYourself Clinics	n	%	% reported to have played BitB
Age range			
Less than 10	0	NA	NA
10-14	0	NA	NA
15-19	200		0% (0/200)
20-24	1037		0.5% (5/1037)
25-34	1436		1.5% (21/1436)
35-49	214		0.9% (2/214)
50+	21		(0/21)
Not disclosed	187		0.5% (1/187)
Gender			
Male	2255		0.9% (20/2255)
Female	443		1.4% (6/443)
Transgender (male to female)	27		4% (1/27)
Transgender (female to male)	2		(0/2)
Not disclosed	368		0.5% (2/368)

Notably in the period December 2017 to September 2018, 9% (99/998) of survey respondents from Davao reported that the game had played a role in them attending the clinic, compared

[20] Due to a miscommunication with clinic staff, paper forms from LoveYourself Uni were sent to LoveYourself Anglo for collection by the research team. The forms were stored securely in the same location in the clinic. As it was not possible to determine which of the two clinics the paper-based forms had been completed in the data was combined for the analysis.

with 0.9% (29/3085) of respondents from the two LoveYourself clinics in the NCR in the same time period. Respondents from the LoveYourself clinics who reported they had played the game all reported that the game had played a role in their attendance at the clinic. In DRHWC, more respondents reported they had played the game than those who reported the game had played a role in them attending the clinic. The survey showed that a majority of the 178 respondents in DRHWC who reported that they were aware of the game discovered it through a friend (63% 112/178), whereas respondents who reported they were aware of the game from the LoveYourself clinics predominantly discovered the game through online and print advertising (76% 104/140).

In January 2018, a peak in HIV testing uptake was observed at DRHWC through analysis of the clinic register. During the month of January 2018, 43 respondents reported they had played the game. This was the highest reported monthly game use in the period 1st December 2017 – 31st October 2018.

Clinic survey data indicates the game was not a major contributing factor in the observed trends. Additionally, the game appeared to be more popular in Davao and this difference could be explained by the manner in which the game was discovered and promoted as part of World AIDS Day celebrations in the region.

4.4.3 National Level Trends Associated with HIV Testing

The first week of December 2017 saw rapid uptake of the game with 367 installations recorded in one day. Google Trends showed search popularity for the term 'HIV test' peaked in December 2017 (Figure 4-15) [112].

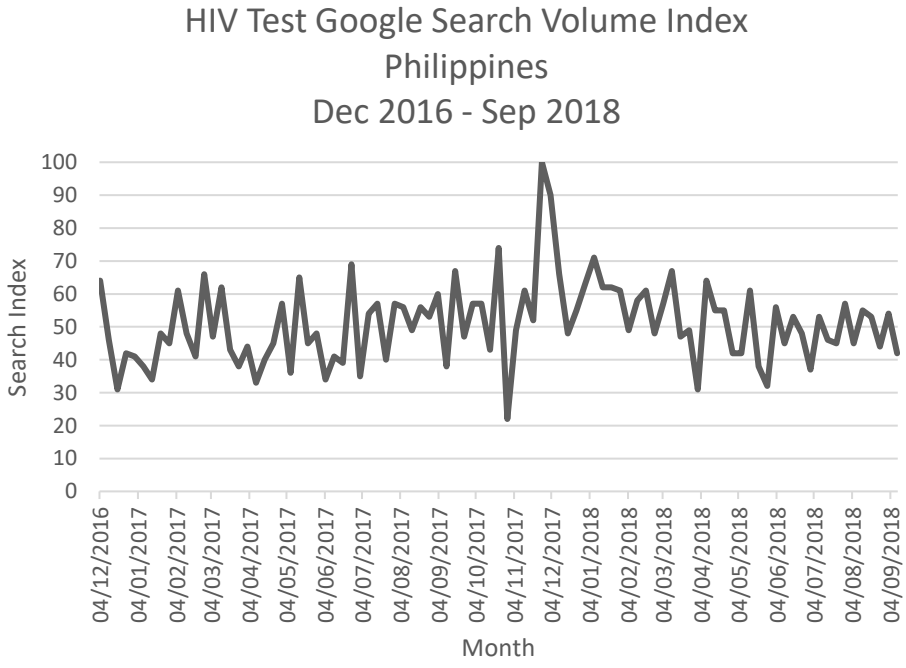


Figure 4-15: Google Search Trend – Data exported from Google Trends and analysed in Excel

The Google search volume index ranges from 0-100, the numbers represent the search interest relative to the highest point on the chart for the selected region and time. A value of 100 is the peak popularity of the term. Similar trends were observed for related search terms, namely 'HIV test kit' and 'HIV symptoms.' Rapid uptake of the game correlated with increased HIV diagnosis among young populations and peak interest in HIV testing observed at the national level. In addition to observed Google search trends the Philippines national HIV/AIDS and ART registry reported 332 new HIV cases among 15-24-year-olds and 66 among 10-19-year-olds in December 2017, representing a percentage increase ranging from 15%-32% compared to reported cases among 15-24-year-olds from November 2017, January and February 2018, and a percentage increase ranging from 39%-67% among 10-19-year-olds in the same period [113].

In December 2017 the game was just one of many HIV advocacy events taking place in the Philippines and so it's contribution to these observed trends remains unclear.

4.5 Discussion: Implication of Findings

Game acceptability

Participatory design workshops supported the identification of contextual requirements for the game design [99]. Qualitative methods provided a deep understanding of important factors that both motivated and enabled gameplay, which are likely to have contributed to the game receiving an overall positive response during the prototype testing sessions and promising uptake of the game once launched. It would be reasonable to conclude from the prototype testing sessions that the game was deemed acceptable as both an entertainment game and behavioural health intervention among the participants and therefore held potential to achieve its behavioural goals. However, the reported low rates of game completion after game launch indicate that optimal design solutions were not achieved by the game's producers which could stifle the impact of the game on health-related behaviour.

Each design choice made by the development team was prefixed with a discussion on what was feasible within the pre-determined budget and development timeframe. For example, an action RPG in which the player controlled their character's strength and traits was found to be highly desirable, but adequate resources were not available to implement a stable and balanced underlying mathematical model for this feature. In this case, the design workshops supported the identification of a wicked problem, the solution of which was informed by the experience and best judgement of the game's co-producers [103]. As the ability of the player to control their characters strengths and traits was assumed to have no additional pedagogical or behavioural benefit it was not prioritised. This assumption may have been misleading as inclusion of this feature could have made the game feel less repetitive, a frequent criticism from the prototype testing session. This in turn could have increased the likelihood of players

witnessing characters and narratives they identify with, influencing their emotional response to the games content.

Indications of game effect

The conceptual framework for the game posited that the game's content would directly influence salient beliefs around HIV testing and treatment. Data collected during the prototype testing sessions was not sufficiently powered to determine if there was a significant change in reported knowledge and attitudes pre- and post-gameplay. The experience of playing the game and participating in discussion around the in-game narratives resulted in a positive change in reported knowledge and perceived stigma for most participants in the prototype testing sessions; although the extent to which knowledge and attitude change can be credited to the act of playing the game versus group discussions is unclear.

Qualitative assessment using the transcripts from the prototype testing sessions demonstrated that intently watching the animated stories and participating in discussion influenced participants' relational understanding around the benefits of early access to HIV services as well as the consequences of delayed access. When played during a facilitated group gameplay session, with subject matter experts, and with guarantees that all animated stories had been viewed intently, it can be said that the game had a positive influence on knowledge and attitudes. Without these conditions, the effect of the games content on knowledge and attitudes may be less impactful.

Data obtained from the study clinics on HIV testing uptake suggests that instances where the game achieved its behavioural goal were rare. What remains to be answered is why did the game appear to have a limited effect on behaviour? Does the design flaw lie in the games focus on intrapersonal determinants of HIV testing behaviour, is it in the appeal of the gameplay or marketing strategy, is it in the delivery of the animated narratives, or is it a combination of these factors? Could external barriers to HIV testing outweigh the positive influence of the game e.g., social stigma or testing access? Within game experience research it is argued that 'social processes and interpersonal dynamics are underrepresented in conceptualisations and theoretical deliberations of game experience and enjoyment [46].' Within the games for health field, the same could be argued for theoretical deliberations of game effect on health-related behaviour. To address this concern, further evaluation of the games effect on behaviour will take a more holistic approach to explore user experience, expanding beyond interpretation and perception of the games content to include social contexts of play and how these relate to meaning the player derives from the game and its subsequent impact on their behaviour.

The benefits and pitfalls of game analytics

Telemetry and geolocation data are widely used in the mobile games industry to improve app revenue. There are countless articles ranking key performance indicators by their value to app

developers. In response to demand, a range of services are now available that process large volumes of data into actionable information with very low setup costs. In the case of the Unity Analytics service (v.2017.1), standard metrics (e.g., daily active users) can be obtained by installing a free software development kit through the Unity game engine and toggling a switch. While generating income may not be a primary goal, it could be argued that analytical services that capture data during gameplay are currently underutilised in games for health development and evaluation as they provide useful and unbiased information on player characteristics and game use [114]. In contrast to playtesting sessions, telemetry and geolocation data collected through the game are not biased by the presence of a researcher, however, emotive responses to gameplay cannot be captured this way, and missing data can present challenges in interpreting the data. Thus, it is important not to focus solely on one data collection technique but rather to triangulate results from a range of different data sources in order to mitigate bias while providing a more complete picture of game performance.

Compliance with data protection regulation may not necessarily equate to users understanding what data is collected and how it is processed in order to give informed consent. While effort was made to ensure data privacy information was accessible to BitB users (e.g., by keeping the privacy policy concise and written in plain English on a webpage which supported web browser translation tools), I was still reliant on users taking the time to read the app store page and privacy statement. Previous studies have repeatedly found that privacy statements and terms of service policy are widely ignored by the public [115], so it is likely the same will be true for BitB. Therefore, further evaluation will be conducted to explore user's awareness and perceptions of data collected by the game to assess if they were appropriately informed.

4.5.1 Limitations

Prototype testing sessions

As with all qualitative research, findings cannot be applied to the wider population with certainty. Perceptions from under-18s and subjects outside Manila and Davao were not captured. While the project team failed to recruit TGW during the game design and game development process, they were included during the formative research stage which informed the conceptual framework for the game (Figure 3-6). Feedback on how the transgender character in the game was portrayed was provided by TGW known to the research team in the Philippines in an informal capacity.

The recruitment strategy and use of FGDs is likely to have resulted in a bias towards participants less encumbered by stigma towards their sexuality or HIV status. Given that recruitment adverts stated that participants would be inputting into the design of an HIV

advocacy game, this may have also created a bias towards individuals with a vested interest in health advocacy and/or game design.

Timing for prototype testing was not ideal, which is believed to have impacted the changes implemented in the game design. The technical service agreement with EM Studios covered development costs up to 31st December 2017. Prototype testing sessions were held between 20th August and 18th November 2017, thus any required changes that emerged from these testing sessions had to be feasible within a four-month period or would have delayed the launch of the game and incurred additional development costs. This impacted the team's willingness to make any substantial changes to the game design.

Certain terms used by participants did not have a direct English translation which, at times, led to ambiguity in the data during the translation process.

Quantitative analysis of the games effect on knowledge and attitudes provides limited insights as it is not possible to determine if participants altered their responses as a result of interaction with the game, the group discussions or a combination of both.

Game analytics

The provision of offline gameplay meant that actual game use could not be determined through the game analytics and it is likely that the rate of progression in the game was not as poor as the data reported. The playtime data was unreliable and had to be excluded from the analysis. Player characteristics was generated from self-report data, users may have been motivated to provide false information, such as reporting their age above 18, because content in the game.

Uptake of HIV testing services post game launch

Data on uptake of HIV services post-game launch did not provide evidence on the causal effect of the game. The overall response rate to the clinic survey was 13% at the LoveYourself clinics and 34% at DRHWC which was well below our target of 60%, impacting the representativeness of the findings. Additional training was held with clinic counsellors in February 2018 to increase awareness and understanding of the clinic survey which resulted in improvements in the response rate but failed to reach our target. There was a potential inherent bias where clients more appreciative and knowledgeable about the game could be more motivated to complete the survey. At DRHWC, there were four respondents in December 2017 who reported their age as less than 10-years-old but in the clinic register there were no recorded HIV tests conducted on clients less than 10-years-old, this could indicate that respondents misinterpreted the survey questions and therefore the accuracy of the data is unclear.

Chapter 5: Exploring Impact of the Game on Target Users: A Qualitative Sub-study

This chapter presents a qualitative study into the effect of the game on target users (objective 4). The primary data source is a series of interviews with game users in the National Capital Region and Davao Region. Methods were informed by findings obtained during the development and launch of the game.

5.1 Introduction

This final study presents an exploratory inquiry into the impact of the game on behaviour and behavioural intention from the perspective of the user and attempts to unpick the mechanisms which underpin the instances where the game achieved its behavioural goal. The targeted behavioural outcome was defined as undergoing HIV testing and counselling from a legitimate provider when the individual perceives they are at risk, with timely linkage to care if reactive. The overarching aim of this study was to better understand the game's contribution to HIV testing behaviours within the wider system of HIV promotion, education and services in the Philippines.

Semi-structured interviews were conducted with game users during the period 15th to 31st of October 2018, just under 11 months after game launch. Individual interviews were chosen to enable participants to speak freely on a sensitive topic.

The objectives of the study were as follows:

1. To explore extrinsic and intrinsic motivators for game use.
2. To examine the real or perceived effect of the game on knowledge and attitudes towards HIV and HIV services, as described by the user.
3. To examine if changes in the user's attitude or knowledge resulted in new behavioural intention and action. With respect to:
    a. the type of action taken;
    b. the ability of users to act on intention;
    c. the perceived or actual consequences of the action taken.
4. To explore factors underlying the real or perceived effect of the game, inclusive of (but not restricted to) the context of gameplay and perception of the game.
5. To explore user's understanding of data collected through the game (game analytics).

During the development of the game (chapter 4) it was established that the game had the potential to influence knowledge and attitudes, this was addressed again in the interviews on the assumption that the games influence on individual perceptions may differ when played outside a facilitated session.

5.2 Methods

Recruitment

Participants were recruited through responses to adverts on Facebook and Steam forums, through consultation with peer counsellors at the study clinics or through recommendation by another participant. Consultation with peer counsellors enabled the recruitment of users who had reported to them that the game had played a role in them attending the clinic. To be eligible for interview, participants had to have installed and played the game after the 1st of December 2017, report as male or TGW and be aged between 18-30-years-old. We focused recruitment on MSM and TGW but opted not to exclude male users who reported as heterosexual to see if their perception of the game and its impact on them differed from our target population.

Data collection

Semi-structured interviews were conducted in the study regions in Mandaluyong City (in the NCR) and Davao city; face to face in public cafés in a secluded area. I conducted interviews in English, trained Filipino research assistants conducted interviews in Tagalog[21]. A minimum of two researchers were present at each interview, one to lead and the other to take notes and ask follow-up questions. Permission for an interview followed the principle of informed consent. The interviewer explained the nature of the study and assured the participant of confidentiality. Interviews typically lasted between 30-60 minutes, were audio recorded with consent, transcribed and translated to English. The translation was checked for accuracy by Filipino members of the HIV GET Tested team.

An interview topic guide was developed and informed by the evaluation objectives (Appendix 7). The interview explored six topics: extrinsic/ intrinsic motivators for game use; perceptions of gameplay and narratives; perceptions of in-game questions and game use data; impact of game on knowledge and attitudes towards HIV and HIV services; enablers and barriers to act upon behavioural intentions and participant demographics. Caution was taken not to include leading questions. For example, at no point were participants directly asked if the game had encouraged them to undergo a HIV test, instead participants were asked if they had ever been tested for HIV and then probed on when they were most recently tested and what led them to get tested on that occasion. The topic guide was piloted with Filipino research assistants and a debrief was conducted after each interview to refine the questions.

Analysis

A combination of inductive and deductive approaches to the analysis was taken; while exploration was guided by a pre-determined conceptual framework of game effect (Figure

[21] Tagalog is the language spoken in the NCR, Cebuano is spoken in Davao region. All interviews were conducted in English or Tagalog but in Davao region two of the respondents recruited through DRHWC spoke in Cebuano, a HIV counsellor from DRHWC was therefore present at the interview to translate and supported the translation of the transcripts to English.

3-6), a solely deductive approach could preclude the development of new theory to better explain mechanisms in which the game effects behaviour, if it did so at all. The analysis was informed by a “general inductive approach” to qualitative analysis [116] and the construct and test logic models analytic strategy by Yin (deductive) [117]. Combined these approaches resulted in the following steps; I) the raw data was condensed into brief summary format, II) links were established between the summary of findings and the study objectives (see section 5.1), and III) the extent to which the conceptual framework of game effect was evident in the data was assessed. Descriptive coding was conducted by two members of the HIV GET Tested team using three transcripts. Codes derived directly from the text were discussed to support the development of a coding framework where codes were grouped into categories. Using the coding framework, I coded the remaining transcripts and interpreted the data.

5.3 Results

25 game users were interviewed. Table 15 presents a breakdown of the participants demographics and progress made in the game at the time of the interview.

Table 15: Interviews with game users, participant demographics

Region	NCR		Davao	
Age range	n	%	n	%
18-21	4	0.16	0	
22-25	2	0.08	2	0.08
26-30	9	0.36	4	0.16
Not disclosed	3	0.12	1	0.04
Education level				
Highschool graduate	1	0.04	2	0.08
College student	8	0.32	1	0.04
College graduate	8	0.32	4	0.16
Vocational training	1	0.04	0	
Employed				
Yes	11	0.44	5	0.20
No	6	0.24	2	0.08
Volunteer	1	0.04	0	
Gender identity				
Male	15	0.60	7	0.28
Transgender (Male to Female)	3	0.12	0	
Sexual identity				
Homosexual	8	0.32	4	0.16
Heterosexual male	7	0.28	1	0.04
Bisexual	2	0.08	2	0.08
Not disclosed	1	0.04	0	
Level reached in game				
11-20	4	0.16	0	
21-30	7	0.28	0	
41-50	2	0.08	0	
51-60	0		1	0.04
61-70	0		1	0.04
71-80	0		2	0.08
81-90	5	0.20	3	0.12
Recruitment				
Recommended by peer counsellor	5	0.20	6	0.24
Responded to advert	6	0.24	0	
Recommended by participant	7	0.28	1	0.04
Total	18	0.72	7	0.28

Five participants from Davao disclosed their HIV positive status at their own discretion, one was diagnosed after discovering and playing the game. Participants with college level education were disproportionately represented in the sample. The frequency in which participants played the game and their rate of progress varied, for example some completed the game's 90 levels within 2 days, others downloaded the game several months prior to the

interview and had completed a third of the game. Participants from Davao tended to have completed more of the game in a shorter period of time compared to participants from NCR.

Motivators for game use

A majority discovered the game through recommendation by a friend or colleague. The game was often described to them as a typical match-3 style game about HIV which is "*informative*" and made by Filipinos. Two reported to have discovered the game through marketing activities while many were not aware that advertising for the game existed, indicating that uptake of the game was primarily driven through word of mouth. It was evident from the data that peer counsellors at the study clinics were actively promoting the game.

Participants were motivated to play the game because they were intrigued by the premise (i.e., a game about HIV). Personal motivation to play the game stemmed from a desire to learn more about HIV. For those who reported to be very knowledgeable about HIV their personal motivation to play the game stemmed from an existing interest in HIV, a curiosity on how the topic would be addressed in the game and the specifics that would be covered. Insights derived from the data suggest that the premise and educational aspects of the game were heavily promoted among peers as opposed to the gameplay and enjoyment aspects.

Participants recruited through online adverts or through recommendation by another participant typically had a vested interest in gaming; they were intrigued as to how an educational game produced by the University of the Philippines and PDOH would compare in terms of quality and gameplay to other games on the market; their motivation to play the game was driven by the opportunity to share their critique and expertise with the developers:

> *"Like, today, a friend of mine was the one who told me to play the game because of this interview, so I played it…I'm a multimedia artist, so basically, part of what I do is related to the gaming industry, like I take part in assessing how attractive the game is those sort of stuff. So, I'm judging the game based on its technicality. So, I asked some of my colleagues about their opinion about the game, and they went on to say that it's boring but informative. They were all saying that it lacks something."*

The ability to play the game anytime for free without the need for an internet connection was a dominant factor in continued game use and the game's ability to compete with other freemium mobile games. Participants in the NCR where the traffic is notorious often played the game while commuting to pass the time:

> *"I played it mostly because my mobile data was depleted. So there's no way for me to play online games. That's the time that I switch to playing BitB, because it's offline and it's free of charge. Also, I have work right now, and my window time to play games is during commuting hours."*

Participants would also play the game during free time at work, however some noted that they would do this discreetly because the game's premise could lead to unwanted disclosure of their sexuality or HIV status. A secondary factor in continued game use for some participants was the animated narratives and a desire to witness the stories unfold. The appeal of the animated narratives was prominent for participants who were HIV positive or knew someone else that was HIV positive. Participants believed the game would be more appealing to users who had personal experience of HIV as they could relate to the game's narrative and characters, as illustrated by this quote:

> *"I have two friends whom I've shared the game…they feel like they're bored with the game. Here's the thing, you'd have a better chance to relate with the game if you already have an experience or you have a friend who has similar experience to ones depicted in the game."*

Heterosexual participants tended to describe the animated narratives as informative or educational, whereas MSM and TGW used descriptive terms such as relatable and interesting.

Effect of the game on knowledge and attitudes

Participants were able to recall key plot points and health messages from the game's narrative, demonstrating that users intently watched the animated stories outside a facilitated environment. However, participants also reported witnessing friends repeatedly tapping the screen to skip the animations. While the skip function was disabled on the first play through to prevent this from happening this feature did not work if the game was installed via Bluetooth. Some participants were also critical of the animated stories and felt there were better ways to convey the health messages and make the stories more immersive.

The game appeared successful in increasing awareness among users of the availability and benefits of HIV treatment, as illustrated by this conversation:

> *Respondent: I think the key take away that I've learned from it [the game] is that HIV is actually treatable, the technology and medicine, what is it, antiretroviral drugs is doing its job properly right now and it's not like the end of the world if you have it, so you can still have a natural life even if you have contracted the disease. But still it's best not to get it.*
>
> *Interviewer: Would you say that was something you understood before you played the game?*
>
> *Respondent: Actually, I have very little information about how HIV was treated, I only knew from news back then that usually people who have AIDS dies with complication like pneumonia but not really the HIV because it's already in their system. But its good to know, it's new information to me about the drugs, how they treat the patients and even how they would prevent transmission from mother to child and all that.*

Participants also demonstrated increased awareness of the benefits of early access to HIV treatment:

"There's quite a lot of new knowledge that I learned from the game. Because from what I saw in the animations, they all became severe. And I realized that if they get themselves tested for HIV early and regularly, they wouldn't reach that point. But if they are already on that point and they got themselves tested for it, they would know that there's already treatment for HIV and they would be able to prevent further deterioration of their state."

As found during prototype testing, learning was predominantly achieved through interpretation of the game's narrative. Practical knowledge on HIV services, e.g., location of clinics was almost never obtained through interaction with the game. Access to this information required an internet connection which was not compatible with the situations users typically played the game.

The effect of the game on knowledge was not consistent across participants, some acquired new knowledge from the game while others reported that the game reaffirmed what they already knew. Despite this, even participants who demonstrated they were very knowledgeable about HIV prior to discovering the game also reported that they had acquired new information from the game, notably becoming aware of the 'window period' and the importance of early diagnosis. The games effect on knowledge did not appear to vary substantially based on the participants demographics, although knowledge obtained from the game was perceived to be less relevant among heterosexual participants.

The data highlighted two prominent emotional responses to the game's narrative. For some participants, the stories induced a sense of fear. These experiences were associated with the game influencing their perceived risk of HIV and was notable among heterosexual participants where the game had taught them that there is a risk of HIV transmission among heterosexuals. The game's narrative also provided a majority of participants with a sense of hope, as illustrated by this quote:

"I think one of the biggest features about the storyline itself, it's making HIV sound like it's not the end of the world, it really gives hope like to the point that people would really want to get tested because they feel like Ok if I get tested positive I think there's still a way after. Because right now the stigma for HIV in the Philippines is pretty bad that people feel that if you have that you're going to die so it really gives them the hope that ok it alright there's still a way out, although in the same way not giving them the impression that you should be careless."

For the most part, participants believed the animated stories reflected the reality of living with HIV in the Philippines; however, belief that a HIV positive diagnosis would result in loss of important relationships, discrimination and isolation was evident from the data which suggests the game had little impact on the perceived negative social implications of HIV diagnosis. Not all participants derived a sense of hope for the game. Heterosexual participants who did not

view HIV as something that was relevant to them tended to perceive the game as a warning and a means to deter users from risky sexual behaviours.

Participants who disclosed their HIV positive status reported that the game had made them reflect on their current and past behaviours. For some the gameplay acted as a reminder to adhere to their medication to "*keep fighting the virus"* while also providing a therapeutic effect as a unique opportunity to take *"revenge"* on the virus. Others reflected on their diagnosis and expressed regret that they had not tested earlier as illustrated by this quote:

> *"…as I go along [proceeded through the game], the more information that I got from the game, like I was saying 'ah, these are the reasons why people would have this kind of symptoms' I realise why I got tested late. That it was wrong not to get myself tested earlier. Because personally, in my experience, I was admitted in the hospital here in Davao. It was during that time that I discovered that I have it. Because before, I was afraid…The information that they will gain in the game will really make a big difference. So… if I was able to play it earlier, I was informed about it earlier, possibly I wouldn't get into that point where it is already worst, where all symptoms are noticeable."*

Behavioural intention and action resulting from interaction with the game

Prior to discovering and playing the game, 18 participants had undergone HIV testing and seven had never been tested. Of the 18 who had undergone testing, four disclosed their HIV positive status. Of the seven who had never been tested prior to playing the game, one participant from Davao was diagnosed with HIV after discovering and playing the game. In this case, the game provided the tipping point in his decision to access HIV testing and treatment services. He was encouraged to play the game by his sexual partner who died before the interview took place from suspected AIDS complications. During his grief, the game's narrative, in particular the last animated story, helped him cut through the denial and precipitated to act of going to a clinic to confirm his status and access treatment:

> *"I downloaded the game for me to ease away my loneliness, and to prevent myself from thinking that he's gone. I have no one to share the bed, I don't have someone to talk to… so the game would remind me that if I was able to introduce this to him earlier, maybe I'm still with him… I got tested days after playing the game… I became worried about myself because what happened to him [his partner's death] might also happen to me. So I tried hard to face my fears that's why I got myself tested… It's actually a big help. Because what's in the game is the same in reality. There are times that when I'm watching the animations, it would remind me of my partner who died. It makes me reminisce. But I have to fight hard and face reality."*

Of the remaining six participants who had never been tested for HIV four were heterosexual and two were homosexual; three (all heterosexual) reported they had no intention to get tested in the near future as they did not perceive themselves to be at risk of HIV, either because they

were not sexually active or practiced safe sex. The remaining three disclosed an intention to test resulting from interaction with the game but at the time of the interview had failed to act. For two of these participants, testing was not a priority at the time of the interview because of work commitments and low sexual activity. For the third participant, fear over the impact getting tested would have on his relationship with his family and his partner remained a prominent barrier despite demonstrating a clear understanding of the benefits of early diagnosis:

> *"There's a lot of process involved for one to really consider getting tested. If the game alone, though its stories are always telling you to get tested, still one might not consider getting tested. Like for example, personally, there's my family that I needed to consider. They are not that aware, they feel like if you try to get yourself tested you already have AIDS or HIV. And that you have a limited number of days left, something like a death sentence. Although, what you can see from the news is very different, that there's treatment for it, like the earlier you know, the earlier you enroll for treatment, the better. The virus remains in your body but there's treatment for it plus change in lifestyle. Just like in one of the stories in the game. The moment that he knew that he has HIV, he proceeded to get treatment, and at the end of the story, you'll see him exercising. That life goes on…A big part of it, really, is with my family. I really see it as a very personal and intimate decision with myself, that I can't quite come into terms with it."*

The participant was still playing the game at the time of the interview and had reached level 20. He stated that the game was building up his courage to get tested, each time he defeated the virus during gameplay he made himself believe it was a sign that he was negative and therefore didn't need to fear the test.

There was evidence from the data of the game influencing decisions on when and where to get tested among participants with previous testing experience. A heterosexual participant, who had undergone HIV testing prior to discovering the game due to work and visa requirements, learnt about the NGO clinics in the NCR offering free testing services through the external links in the game. He was the only participant out of the 25 who reported to have accessed information on testing services through the game and did so to complete all the in-game achievements, one of which requires the player to open all of the external links in the game. In this case, the game did not motivate the participant and his girlfriend to voluntarily undergo HIV testing but did influence their choice of testing location. A further three participants reported that the game acted as a reminder for them to regularly get tested, one of which tested during the week he played the game.

The interviews provided evidence of the game commonly used as a jovial and reputable mechanism to introduce the topic of HIV to peers and family and trigger important conversations. There was evidence from participants who had previously undergone HIV

testing, or reported to regularly test, using the game to encourage peers to get tested, as illustrated by this quote:

> *"Using the game, I think they might change their behaviour especially when they get to the level where the story is about a young professional, because most of my friends are young professionals. I think they can relate to it and is applicable to them…and we have a friend that we suspect to be positive for Tuberculosis. But she doesn't want to get tested. I don't know how to encourage her to get tested but what I could think of as a solution is to let her play the game because she might be convinced to get tested by the scenarios…I know there will be friends of mine who will submit themselves for testing once they play the game."*

In these instances, the game did not appear to be the catalyst to providing peer support and encouragement as there was evidence this was practiced by the participants prior to discovering the game, rather the game supported existing practices. There was also evidence of participants who disclosed their HIV positive status playing the game with their siblings and parents as a "*lighthearted"* means to increase their awareness.

Factors underlying the real or perceived effect of the game

Participants held modest expectations of the game's effect on behaviour. Many perceived a wide range of factors which lead up to the act of getting tested and while the game, and in particular the animated narratives, could be a contributing factor by raising awareness it was not sufficient on its own. The popularity of the game was perceived by some participants to be a limitation on its potential to effect behaviour, as illustrated by this quote:

> *"The game for me, even though I gained information from it, it's not something that will drive me to engage in testing. I don't see the app as a driver for me to get tested. I think all the information is there, but it needs something kind of viral, this x-factor, something that will make you hooked into the game. Because if you get some people to be hooked into the game, it will really strike a significant conversation within the community, and everyone will have this kind of thinking that they need to get tested."*

The game appeared to have a limited effect on the socially ingrained habits, dispositions, and beliefs of the participants. While the game was successful in influencing cognitive factors of HIV service uptake the ability for the user to act on these thought processes remained dependent on external social conditions i.e., peer support during testing or fear of losing important relationships. Participants recruited through recommendation by peer counsellors tended to operate within social fields which gravitated around HIV services and advocacy and thus their willingness and ability to engage in HIV testing services and talk about HIV among peers was supported by external conditions prior to playing the game. In these instances, the game appeared to reaffirm and support socially ingrained habits and beliefs. Participants who were recruited through online adverts or recommendation by other participants were less likely

to have previous testing experience or feel comfortable talking about HIV with their peers. For these participants the game appeared to have a limited impact on social influences of behaviour as they remained resistant to talking about HIV among peers or promoting testing behaviours. Participants believed the game lacked something in its design to make it go *"viral"* increasing its impact on the wider community by delivering something *"that would really get people talking*."

The interviews demonstrated that positive action was taken if the user encountered a character or storyline to which they could directly relate to; or recognised key commonalities with their current situation or social group. Notably it was the stories towards the end of the game which appeared to resonate the most with MSM and TGW participants, indicating that a strong desire to complete the game was associated with its potential to effect behaviour.

For participants already engaging in HIV advocacy the game was viewed as a good supporting tool for HIV and sex education. One participant advised that the game should be implemented alongside improved sex education in schools, noting that condom use and the availability of HIV testing and treatment services were not taught as part of their formal education and felt the game was not the right forum to introduce this information, as illustrated by this quote:

> *"I feel like if the goal is to encourage people, there should be a primary means that should be implemented first before this [the game] to encourage them to get tested…I really think that there's something that you need to implement first before you impose the game. Like the game is a complementary material for a media or medium; that there should be a preliminary activity first before you implement this to create awareness… Because, for example, we [at his place of work], we do not have any orientation about HIV, considering that our workforce is mostly composed of young people... Because I feel like, when we were in college, I was never aware that one should use condom. We entered college but there's no orientation about that. It's only when I was working that I came to know about that."*

Understanding of data collected through the game

It was evident from the interviews that none of the participants had accessed the games privacy policy or app store description which provided details on how data collected by the game was managed by the research team. Despite this most participants demonstrated an accurate understanding of the purpose of the game analytics to monitor the demographics of players and their geographical location. A majority granted permission for the game to access their devices location data, device storage and responded to the in-game demographic questions because they believed that not doing so would restrict access to the game. This assumption stemmed from previous experience of mobile games. Participants also felt confident that the game would not be able to identify them as they did not provide certain personal information such as their name or contact details.

One participant was evidently conscientious of his privacy and reported that he had deliberately given false responses to the in-game demographic questions and disabled permission to access his devices' location data and internal storage. The participant described the conditions that would need to be met for him to be willing to share personal information:

> *"If it will let me know how my information is going to be shared it will of course impact how I am going to give out my information. So I think it's safe, nothing's going to be compromised then I think I will be willing to give more information… one additional thing that might lure players to grant permission is if ever they would have any specific kinds of upgrades, a lot of games use that."*

Some participants believed responses to the in-game demographic questions impacted the games content, for example responses to the question on the player's age would be used by the game to ensure the content was age appropriate. Some participants also stated that they felt comfortable responding honestly to the demographic questions as no one was looking at their answers. Findings indicate that obligations under data privacy law were not sufficient to ensure users understood what information was collected and how data collected through the game is managed.

5.4 Discussion

The aim of the study was to better understand the game's contribution to HIV testing behaviours within the wider system of HIV promotion, education and services in the Philippines. Evident from the data was the interplay between the impact of the game and the participants social reality. Within identity theory it is suggested that we have an innate need to maintain consistency between the values associated with our identity and the information we encounter [118]. Our identity also shapes the groups we identify and regularly interact with. Thus, we process information in ways that support our position in the social fields we belong to. From this perspective, the way in which a player processes and acts upon the health information within the game will remain dependent on the perceived rules and rhythms of the social field they are a part of. Many of the participants recruited for this study operated within social fields which gravitated around HIV services and advocacy, evident by reported testing and social behaviours prior to playing the game. For these participants the game enhanced their ability and willingness to share their interests with peers and family, while reaffirming their current beliefs and practices.

Recommendation of the game was predominantly driven by perceptions that the games premise and narrative would be of interest. As a result of this the game appeared to spread at a faster rate among social groups who were already highly motivated to talk about HIV. The importance of 'social pressure' as a predictive factor for HIV testing was evident from the data, for a majority of participants, peer encouragement was a dominant factor in their engagement

with testing services. It was therefore promising to see the game provide social capital as a jovial and reputable mechanism in peer encouragement to test. The limited appeal of the gameplay may have been a hinderance as interest in HIV was a prerequisite to continued use and promotion of the game. Participants who were motivated to play the game because of their interest in gaming tended to be less motivated to complete the game or recommend the game to peers.

Of the seven participants who had never tested; three did not perceive themselves to be at risk, two perceived themselves to be at low risk and did not view testing as a priority, one remained fearful of the negative social implications of a positive diagnosis and one was diagnosed with HIV after playing the game. It can be gleaned from these seven cases that the game's effect on behaviour was not isolated from the players reality. In the one instance where the game triggered testing behaviour, the meaning the participant derived from the game's narrative and impact on his attitude towards testing was shaped by the recent loss of his partner to suspected AIDS complications. Relatability and immersion in the game's narrative appeared especially important.

Reflecting on findings from this study the conceptual framework for game effect shown in Figure 3-6 was revised to map out the predicted game effect within the real-life context of play (Figure 5-1). Fishbein's Integrative Model of Behaviour Prediction remained a good fit and the perceived advantages of accessing HIV treatment early, fear over the consequences of delaying action and hope for the future after a positive diagnosis appeared especially important in generating a strong willingness to test. Exploration into the game's effect on knowledge and attitudes demonstrated that learning was predominantly achieved through interpretation of the in-game narrative with the most prominent effect on perceived advantages of early HIV diagnosis and access to treatment, secondary was the games effect on reducing the fear associated with a positive diagnosis. Effect on the remaining individual perceptions was less evident. The conceptual framework was revised to show the effect of the game on individual perceptions in order of probability.

Where 'individual perceptions' divert from the original model is through the inclusion of 'perceived risk of disease.' While participants could clearly recognise the intent of the game to encourage users to get tested this message was only relevant if they perceived their recent activities to have put them at risk of HIV.

The original conceptual framework predicted that the game would increase practical knowledge on HIV testing services increasing the user's ability to undergo HIV testing, but insights from the interviews combined with the game analytics, in which 115 users were reported to have clicked on weblink containing a list of HIV testing services in the Philippines, suggest that the game was not used as a primary mechanism to link to this information.

In the revised framework, potential game influence is encompassed by the level of enjoyment and narrative relatability experienced by the player, incorporating findings of the importance of narrative relatability and its associated effect on individual perceptions, and the notion that the more a user enjoys the game the longer they play it and the more likely they are to recommend the game to their peers.

Lastly, the interplay between the impact of the game and the participants social reality is reflected in the revised framework through the inclusion of social field habitus and doxa under modifying factors and encompasses both individual perceptions and behaviour. Where the behaviour change game operates at the individual level, as is the apparent case for BitB, its potential effect is limited without the necessary conditions for behaviour change at the spatial level (social field).

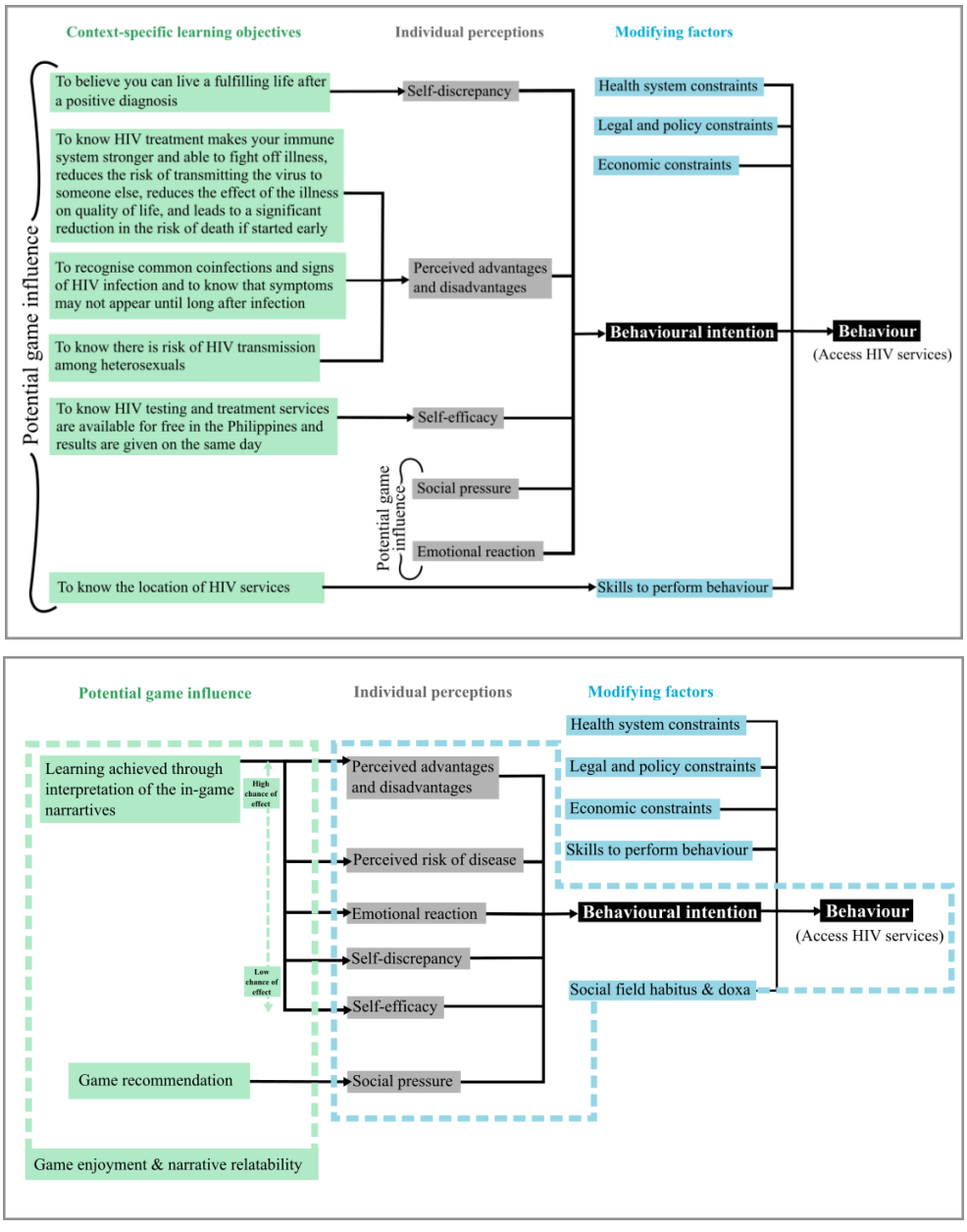


Figure 5-1: Above: original, below: revised conceptual framework for game effect

5.5 Limitations

Limitations of the study were similar to previous qualitative evaluations of the game (see section 4.5.1); for example, the recruitment strategy likely resulted in a bias towards participants less encumbered by stigma towards their sexuality or HIV status. Recruitment resulted in only seven participants who had never tested prior to playing the game with a majority of participants demonstrating regular uptake of HIV services and good knowledge of HIV, the sample is therefore unlikely to be representative of the wider target population for the game.

Chapter 6: Discussion: Guiding Principles for Behaviour Change Games in the Health Development Field

The final chapter pulls together findings from the multiple studies presented in the thesis and discusses the methods deployed during the design and development. It describes the contribution of this study to the games for health literature, including new insights on game evaluation and guiding principles for the application of behaviour change games in the health development field. The chapter concludes with the overall limitations of the study, and recommendations for future research.

6.1 Summary of Main Findings

The primary aim of the study was to explore the contribution and limitations of a tailored digital game for health aimed at improving HIV-related knowledge, attitudes and practices among young key populations in the Philippines. A theoretical evidence-based approach was taken in the game design. The literature review and formative work combined to focus the game's learning objectives on benefits of knowledge of status. Representative population data revealed low rates of testing among young key populations. The baseline assessment revealed that study HTC clinics were operating close to capacity; that the vast majority of clients coming to the clinics reported as MSM or TGW; that certain HIV-infected populations were not engaging with their services; and the availability of timely HIV treatment for reactive clients.

The literature review and qualitative formative research strongly indicated that elevating perceived risk of HIV-infection alone was not sufficient to increase engagement with HIV services; a successful behavioural intervention needed to address the fears of positive diagnosis and knowing one's status by offering an optimistic narrative of life after diagnosis with treatment, with practical information on where to find quality free and confidential HIV testing and treatment services and social support in attending the clinics. Findings from the formative research informed the game's learning objectives and theoretical basis.

The game was built by a UK developer (EM Studios) with technical input from a UK physician and Filipino physician, nurse and virologist. Final design choices were made by the game's co-producers: me; Bobby Farmer the director of EM Studios with over 10 years industry experience based in Scotland; and Dr Emmanuel Baja, a Filipino clinical epidemiologist.

The game was found to be acceptable during prototype testing. By involving target users from the outset, the development team were guided towards relatable and understandable narratives and enjoyable gameplay. The resulting product was a game that was accessible and entertaining due to universally recognised game mechanics, with low storage requirements and offline gameplay. The experience of playing the game and participating in

discussions around the in-game narratives resulted in positive changes in reported knowledge and perceived stigma among game testers.

In the 12-months following game launch, out of 3,325 total users, geolocation data was obtained from 1,688 users, of which 1,441 (85.4%) were in the Philippines. As of 01/12/2018, analytics data reported that 15% (498/3325) of users completed level 45 and 4% (133/3325) completed level 90, the final level. While gameplay being perceived as repetitive and having limited appeal were believed to be factors contributing to low rates of game completion, the figures were affected by missing completion data due to offline gameplay.

Research activities at the study clinics indicated that the game was not a major contributing factor to uptake of HIV testing services among young key populations. Overall testing increased by a small amount post-game launch at the study clinics in the NCR to a varying degree, at DRHWC overall testing decreased post-game launch. At DRHWC, clinic renovations, detailed in section 1.5.1, was a key factor in the reduced uptake of testing observed in the first quarter of 2017. During this period the clinic was housed in temporary accommodation impacting access to services. Trend analysis of the monthly clinic register data suggest that HIV testing uptake remained consistent at the study clinics in the NCR. At DRHWC there was a noticeable increase in testing uptake shortly after game launch and the World AIDS Day celebrations taking part in the region, but this increase was not sustained in the months following.

A voluntary survey at the clinic, implemented to track game use among clients at the study HTC clinics, indicated a link between discovering the game through a friend and the game playing a role in clinic attendance, pointing towards an interplay between game effect and the users' support systems and social context.

Exploration into the effect of the game on the targeted behavioural outcome from the perspective of the user provided further evidence of the interplay between game effect and the users social reality. The theme that it is not so much the games content but the context in which it is played and the community which forms around the game which has the greatest impact on behaviour was present in the data. Demonstrating the importance of incorporating triggers for social interactions in the game design and implementation strategy.

6.2 What this Study Adds to Games for Health Literature

6.2.1 The Social Context of Behaviour Change Games

This study demonstrates that behaviour change techniques such as persuasion, education and modeling, can be delivered not only in the game's content but also in the social context of gameplay, and that there is a dynamic interaction between the games content, the social context of gameplay and real-world behaviours. Digital gameplay as an activity does not occur in a vacuum, users talk about games, share strategies and participate in a gaming community

which can span multiple media platforms [119]. It has been previously established that social experiences in games can increase the appeal and longevity of the game [120], now the question is can social experiences in behaviour change games increase the effectiveness? Insights from across this study suggest this is something worth exploring.

The very idea to use a game-based intervention in the Philippines' context was built on the observed link between intense online gaming and HIV risk. DOTA 2 is an extremely popular mass multiplayer online game (MMO) in the Philippines. The DOTA 2 fever that swept across the Philippines, and is still present today, is largely credited to the popularity of internet cafes which have been the venue of choice for DOTA players to meet up, train and compete. The average hourly rate of these cafes ranges from 15 to 30 Philippine Pesos and are predominantly used by impoverished urban residents that do not have access to gaming hardware at home [121]. In DOTA 2, players work in teams and as such become duty bound to put in the hours to maintain their standing in the team. This pressure results in at-risk youth taking extreme measures to cover internet café fees. This phenomenon highlighted a link between social experiences in games and real-world behaviour.

This thread continued into the design phases for BitB. During the participatory design workshops to establish user preferences (section 3.3), the concept that it is not so much the games content but the community which forms around the game that has the greatest impact on behaviour was quite paramount from both groups as they spoke about their experiences with gaming. Multiplayer gameplay was reported to be a strong motivator for repeated gameplay and was perceived to play a role in the effectiveness of the game on HIV related behaviours. While this provided further evidence of the importance of social experiences in gaming it also presented a dilemma for the game design. On one hand, multiplayer gameplay was a very desirable game style among the participants as they could participate in discussions about HIV, behaviour and personal values and co-construct their own narratives about a desired future. It was also believed that multiplayer gameplay fostered a stronger gaming community which interacted on a regular basis. On the other hand, we did not have the resources to develop and maintain an online multiplayer platform and known issues around internet connectivity would restrict access to the game.

The most intense social gameplay is found MMO games, such as DOTA 2, where thousands of players interact with one another in real time over the internet. Within the confines of public funded research, BitB was never going to be able to compete with the likes of DOTA 2. The cost of developing and managing MMO games is enormous. As well as potentially high initial development costs to build the complex backend needed for MMOs, costs continue after the game is launched to safeguard players, patch bugs and provide new content. As developing an MMO was not feasible in this case we explored alternative strategies to capitalise on the social effects of digital gaming. While social aspects were limited in BitB's content, the game

was connected to an active Facebook page managed by Filipino researchers (facebook.com/HIVGET). As well as advertising the game and research activities for the study, the Facebook page regularly shared news articles about HIV in the Philippines, information on HIV testing and treatment services and provided tailored advice to Facebook users. As of January 2021, the Facebook page had 1,450 followers and regularly ran paid posts to reach a wider target audience. Recent posts included information on coronavirus for PLHIV and invitations to participate in research on HIV self-screening in the Philippines. Previous research has shown that social media interventions are effective in promoting HIV testing among MSM, although their use is still limited in low- and middle-income countries [122]. Where available funding negates the opportunity to develop the game as an online social media platform in its own right, developers should leverage existing and popular online social media platforms to host virtual communities and disseminate tailored information, using the game to link users to this space. However, in contexts where internet access poses a major challenge in reaching the target audience, developers should consider strategies to provide social gameplay without the need for an internet connection. This could involve community health workers facilitating group gameplay sessions as part of their health promotion activities.

When exploring the effect of the game on cognitive and social mediators of HIV service uptake, qualitative findings indicated that the game was used as a tool by players to educate peers and encourage others to test. It stands to reason that people, especially those who operate in the same social sphere, are more persuasive than a mobile game; especially with regards to behaviours such as undergoing HIV diagnosis which brings with it a wide array of social implications. Framed this way, this was seen as a positive finding as it demonstrated the games potential to influence social pressure around HIV testing behaviours and other HIV risk behaviours. However, game users also reported that the game lacked something in its design that would '*really get people talking,'* indicating that the game's content was not optimally designed to leverage the social experiences of gameplay and the consequential impact on social pressure. This may in part explain why the game appeared to have limited effect at scale.

Based on these findings the conceptual framework for the game was expanded (section 5.4) to incorporate the social context of gameplay and the subsequent influence on key mediators of behaviour (Figure 6-1). The framework is specific to this case and was underpinned by Fishbein's Integrative Model of Behaviour Prediction. In its current format, it does not provide a general theory that can be taken forward in future research to explore the association between social experiences in behaviour change games and effectiveness.

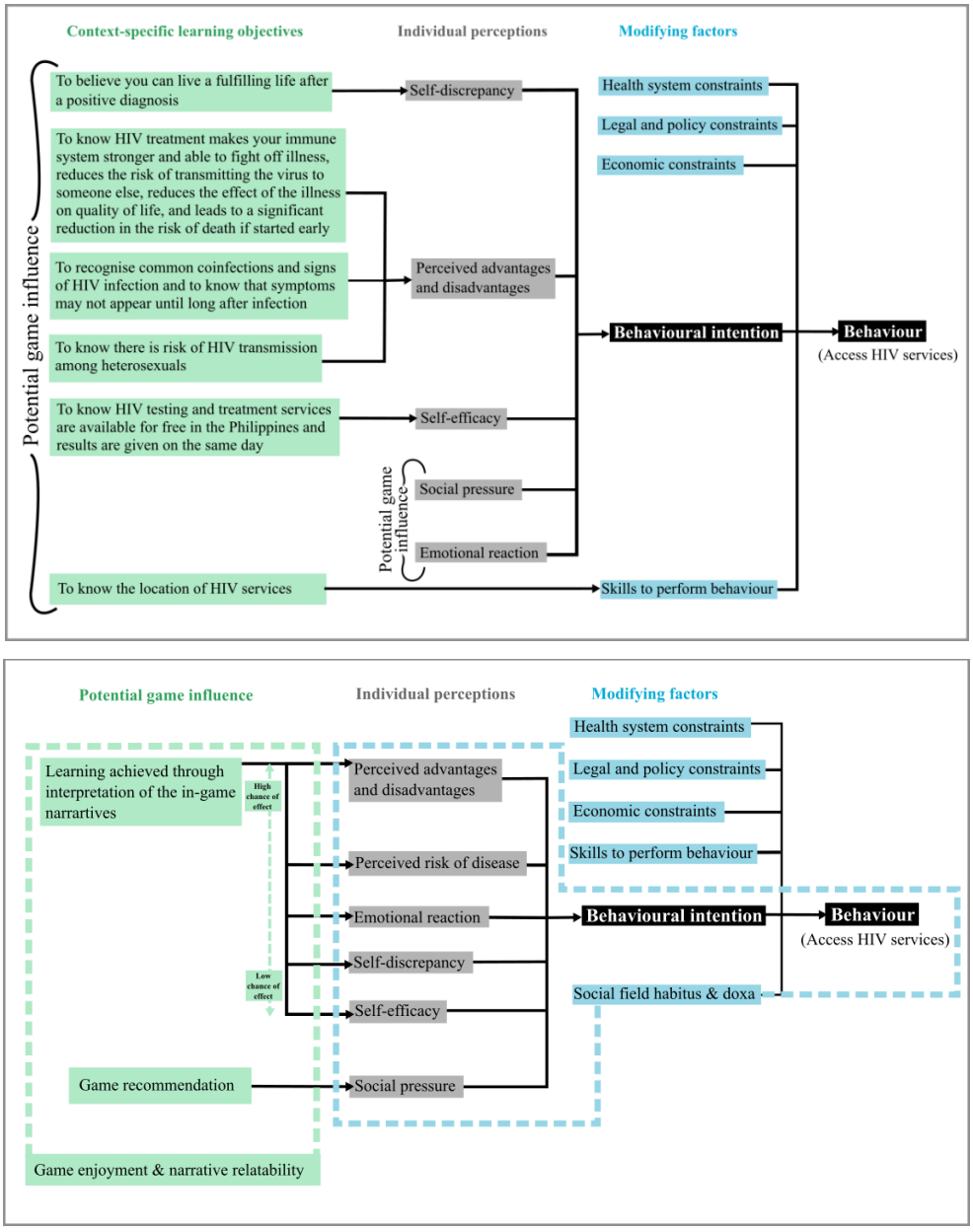


Figure 6-1: Above: original, below: revised conceptual framework for game effect

Taking a step back from the case in question, I reflected on the key differences between the original and revised framework. The original framework was based on approaches to behaviour change games taken from the literature and posits that the games content directly affects salient beliefs through the learning objectives which in turn influences attitudes, perceived norm, self-efficacy and intentions; however, the ability for the user to act on those intentions would still remain dependent on external conditions (modifying factors) which the game may have no influence (Figure 6-2).

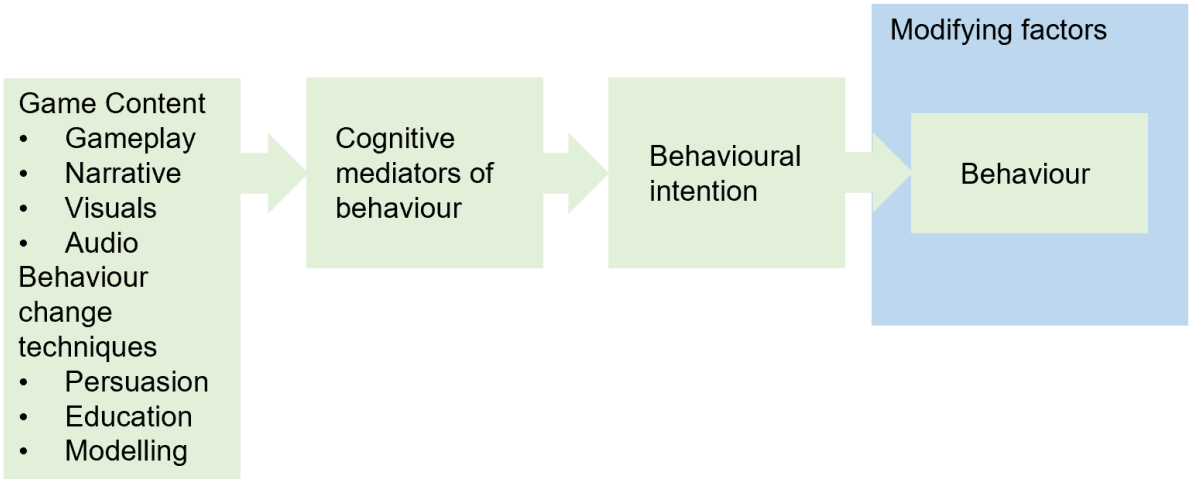


Figure 6-2: Components of the original conceptual framework for predicted game effect

The revised framework did not abandon the common-sense approach of using games to persuade and educate but instead expands on this approach using the social context of gameplay and narrative relatability to maximise the potential of games to trigger real world behaviours (Figure 6-3).

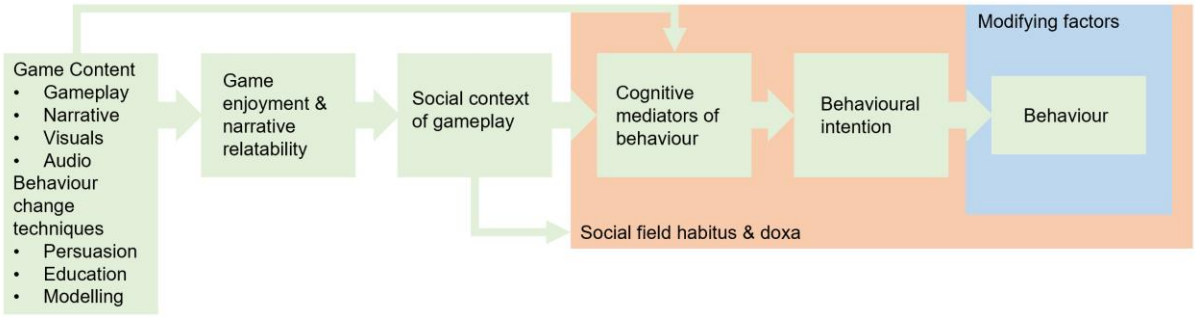


Figure 6-3: Components of the revised conceptual framework for predicted game effect

The green arrows represent the direction of influence. The games content influences the level of enjoyment and narrative relatability, which in turn influences the social context of gameplay, which is connected to both cognitive mediators of behaviour and social field habitus and doxa. The principle idea behind this is that while the games content can influence cognitive mediators of behaviour, it is the social context of gameplay that holds the potential to disrupt the rules and rhythms within a social field, which is linked to an individuals perceived importance of a behaviour and ability to act on new thought processes. This line of thinking could be the missing piece in explaining why empirical evidence of game effect on behavioural or clinical outcomes appears at odds with qualitative anecdotal evidence of the motivational value of games. To maximise the potential of behaviour change games we must expand beyond delivery of health-related content to design theoretically driven social experiences.

6.2.2 Game Design and Development

This study provides guiding principles for the design and development of games for health within the international health development field, building upon guiding principles extracted from the literature and discussed in section 3.1. While adoption of games for social and behaviour change are fairly limited in developing countries their use is rapidly expanding due to increased funding opportunities, and with it comes a need to form effective partnerships in the design and development.

Challenges in the multidisciplinary approach to games for health development are well documented in the literature; agents from differing fields function according to their own rules and logics, use differing terminology, priorities can be in conflict and the creative process is put under stress by resource and time constraints [95]. While research into the application of games for health in the international health development field is emerging [123], the literature is predominantly Western centric i.e., Western teams designing games for Western audiences [124]. As such the integration of context expertise, capacity building and managing the international separateness of agents in the game development team is not well documented.

How target users should be involved in the game development remains under some debate in the literature; however, there is a clear consensus that their needs and preferences should be considered in the design to support the effectiveness of the game [99,125]. Within the context of international health development, situations may arise where agents responsible for building the game share little in common with the target audience, enhancing the importance of a user centred design approach.

Lessons from the experience of designing and developing BitB with the HIV GET Tested team are grouped into three interrelated themes: international development team dynamics; good practices in user centred design; and important design considerations for behaviour change games.

International development team dynamics

1. Ensure agent roles are appropriate to their area of expertise.

Identifying agent roles within the development team begins by recognising the core building blocks of the game. For BitB, building blocks consisted of game mechanics, aesthetics, narrative and health content. Game mechanics are coded objects invoked by agents which facilitate interaction with the game state by the player [126]. In practice they are the controls, rules and physics which define what the player does and how they do it. Combined with audio and visual design elements they form the game's genre, whether that is a first-person shooter, card game or match-3 puzzle. For BitB, game mechanics and aesthetics (important design aspects for fun and player engagement) were led by professional game developers whereas the narrative and health content (important design aspects for the pedagogical and behavioural goals) were directed by the subject and context experts within the HIV GET

Tested team. This benefitted the game by ensuring design solutions were aligned with the professional game developers' style and capabilities and content was technically accurate and culturally relevant.

A potentially overlooked role in the game development team is the narrative designer. For BitB I performed this role. The narrative designer's role must expand beyond producing dialogue and writing in-game text to ensure gameplay and story go hand in hand. If the gameplay is what we do, the story is why we do it. The narrative provides the emotional payoffs and as such is an important design element in behaviour change games. To be effective in their role, narrative designers must understand the game mechanics, the target audience and the behavioural goal. It is important that the narrative designer ensures story elements in the game such as health services or cultural artifacts are accurately represented either through their own expertise or through consultation with relevant experts.

2. Involve game development experts in proposal writing.

A key challenge in grant funded game development is that it can create a situation where the development budget is decided before the game is fully specified. The budget dictates the size, composition and schedule of the game development team, consequently limiting possibilities in the game design. In an ideal situation a detailed specification is used to determine the development costs; where available funding negates the opportunity to do this, involving gaming industry experts in the production of funding proposals is essential for viable cost estimates.

3. Establish an appropriate hierarchical structure in the development team.

Ultimately game development is a creative process, many design problems do not have a clear answer. Tensions can arise when opinions from agents in health, academia and game development are in conflict. Thus, it is necessary to appoint members of the team to resolve such conflict by empowering them to make final design choices. As a general rule, expertise in the context, behavioural goals and game industry should be represented in the team's leadership. Team leaders should also meet early on in the design process and at key stages later on to communicate expectations, identify problems and negotiate possible solutions. It is important to keep accurate documentation and define the objectives and outcomes of each design meeting to ensure efficient communication throughout the development team. At a minimum, a game design document should be produced and updated to incorporate outputs from design workshops, providing a blueprint for those responsible for building the game while maintaining a shared vision of the final product.

4. Utilise design tools to support collective problem solving.

For games aimed at cognitive mediators of behaviour change, application of theoretical frameworks for the development of educational games (i.e., game-based learning theory) provide a structured approach to identifying appropriate game design elements for the transfer

and retention of knowledge and attitude change. The steps outlined in relevant literature involve establishing a set of learning objectives, mapping the learning objectives to pedagogical practice, and then translating the pedagogical practice into a game mechanic. For BitB these activities were conducted with the full development team during an in-person workshop over several days. The LM-GM model (section 3.5) was helpful in producing the learning objective-game design map by encouraging considerations into how people learn as part of the design process.

5. Build professional relationships on shared understanding, goals and mutual respect.

Games for health development can be characterised as a process involving highly interdependent tasks under conditions of uncertainty and resource constraints; because of this, efficient and quality game development requires effective communication and relationship dimensions in the team. Within the field of organisational research, specific dimensions that are integral to the coordination of work have been identified through inductive enquiry and have been applied and evaluated in health service provision through the Theory of Relational Coordination [127]. The Theory of Relational Coordination includes seven dimensions; frequent, timely, accurate, problem-solving communication, and relationships of shared goals, shared knowledge and mutual respect and describes the ways in which these dimensions mutually reinforce one another. Games for health development within the international health development field poses additional challenges in the practicalities of carrying out frequent, high quality communication and establishing quality relationships among agents in the development team. In person communication can incur high travel costs and digital platforms for collaborative work may not be accessible in certain contexts. In grant funded games for health development these challenges need to be considered at the funding application stage and when selecting members of the development team.

Good practices in user centred design

1. Involve target users at multiple stages of the design and development process.

This study highlighted the importance of consulting target users at multiple stages of the development process, aligning methods with the development stage and design questions. A game can be considered as a vast collection of decisions. From the core game mechanics through to the specifics of a level such as the colour of an icon on a puzzle board. Some of these decisions become immoveable pillars of the game design such as the game genre. Others are more easily adapted. You can think of these decisions as pegs in a pachinko and the players as the balls. The players bounce around these decisions in unpredictable ways eventually falling into categorised levels of engagement i.e., bored or enthralled. Involvement of target users during the development of the game enables us to observe their trajectory and move some of the pegs (budget and resource permitting) to ensure most players fall into a positive level of engagement; but until we pour vast number of players in, we really don’t know

if the game will be a success. Tests involving large numbers of players often come at a point when big pillar decisions have been made that are structurally hard to shift.

At a minimum, development teams should involve target users in early stages of the design process as a relatively cost-effective method of cataloguing important contextual requirements and user preferences. If target users are to be tasked with developing design solutions, then interaction with the development team must go beyond sporadic points of contact. For the target user to be a valued member of the game development team, they must have adequate expertise in design, a shared goal, a defined role and be properly credited and compensated for their contributions. Criteria reflected in findings from a meta-analysis of participatory design in games for health research [99].

Playtesting is an important stage in the user-centred design process as it provides key indicators for game acceptability [96]. However, the value of the data generated from playtesting is limited when there is little opportunity or budget to use this information to adapt the game design and improve user experience and uptake. For BitB, timing for prototype testing was not ideal as any suggested changes that emerged from these sessions had to be feasible within a four-month period or would have delayed the launch of the game and incurred additional development costs, which is believed to have impacted the team's willingness to make any substantial changes to the game design. An example being the inclusion of additional social aspects in the game. After the game was launched, game analytics (i.e., playtesting on a large scale) provided further evidence that optimal design solutions were not achieved. Game development projects should be structured with this in mind, ensuring adequate resources for iterative design and design cycles that involves feedback from large sums of players.

Increased reporting of design approaches and stronger collaboration between health professionals, the entertainment games industry and end users will support the games for health industry as it matures. Restructuring projects to involve users prior to determining the development budget will enable design choices to be driven more by user requirements and less by what is feasible.

2. Utilise qualitative and quantitative methods to measure/ explore user experience.

It is important not to focus solely on one data collection technique but rather to triangulate results from a range of different data sources to mitigate bias while providing a more complete picture of game performance. Each method of obtaining user preferences and experience comes with its own limitations and bias. For example, the presence of members of the game development team during qualitative data collection may introduce social desirability tendencies. Participants, especially from hierarchical societies, may view the data collector as superior and experience normative pressure to speak positively about the game and not come across as overly critical [128]. Thus, it is important for data collectors to be able to detect social

desirability tendencies when evaluating the game among target users and implement techniques to minimise bias. During qualitative data collection activities for this study, effort was made to establish rapport with the participants and communicate to them that their views, both positive and negative, were valued by the team and would directly influence the end product. Along with framing questions to draw out what participants would like to include or change about the game as opposed to interrogating them on what they did not like created a supportive environment for participants to share their opinions.

In contrast to qualitative methods, game analytics are not biased by the presence of a researcher and provides objective measures of behaviour as indicators of game acceptability; however emotive responses to gameplay cannot be captured this way.

Important Design Considerations for Behaviour Change Games

1. Identify target user requirements to support game accessibility.

Certain design aspects that can enhance the performance of the game, both in terms of engagement and behavioural goals, may be detrimental to the accessibility of the game, especially in contexts with poor network infrastructure and internet access. Resource intensive graphics and audio will impact the range of compatible devices that the game can be played on, with more expensive hardware needed for games that require high computational power. The minimum hardware requirements must be considered from the outset of the game design and development process and aligned with the target audience. For BitB, the development team purchased three smartphones for internal testing purposes, selecting the cheapest device options from popular brands in the Philippines. This provided a minimum hardware specification for the development team to work towards. Developers should strive to make the game run smoothly on low-end devices without compromising the experience. One strategy to achieve this is to optimise the game for low end devices i.e., deliver different assets based on device quality and disable certain animations or sounds. The experience may not be comparable between the low and high end devices but users with low end devices should still be able to accomplish the same core activities in the game.

Internet access in developing countries poses a significant design problem. Offline gameplay can increase the accessibility of the game and give it a competitive edge over other games on the market, but to the loss of possibilities in multiplayer gameplay and game analytics. Developers should consider desired use cases for the game. If multiplayer or social gameplay is deemed important for the behavioural goals of the game, then can the game be designed to facilitate group gameplay offline e.g., through a turn-based pass and play approach? If game analytics are important to the research objectives, then in-game rewards could be used to encourage the user to play the game while connected to the internet to reduce the impact of missing data while still providing the option to play the game offline.

2. Ensure the game's narrative is immersive and relatable to the target user.

Storytelling has long been established as an effective means of attitude and behaviour change [45] and this was reflected in findings during the user-centred design process for BitB. This also highlights the importance of having an experienced narrative designer as part of the development team to work in partnership with subject domain and behavioural experts. Assessment of the game's acceptability found that mobile game design that accommodates typical user behaviour and accessibility is not always conducive to effective storytelling. To be suitable for use in a public space, the animated stories had to be highly captivating to retain focus while also allowing the player to disengage without missing vital information. While BitB made some headway in delivering a narrative that was accessible and accommodated typical user behaviour, a lack of interaction, an obscure link to the gameplay and delivery through linear episodes may have rendered the animated stories ineffective in generating new knowledge and perceptions for some users when the game is played outside a facilitated gameplay session. These design flaws could be addressed through the inclusion of additional branching narratives driven by player choice; forming a stronger link between the gameplay and cause and effect sequences in the narrative; inclusion of stories based on true events; allowing players to select narratives they are interested in; and facilitating group gameplay sessions where players are encouraged to discuss their interpretation of the narratives as part of the game's distribution strategy.

6.2.3 New Insights on Game Evaluation

While extensive literature in games for health field existed in 2016 it was fractured, lacked structure, and was biased by the field of expertise leading the write-up. The accessibility of guiding principles for the development and evaluation of games for health has improved, notably through the 2019 publication of a framework for the development of games for health established from a qualitative review of 74 studies [125]. While the methodological stages set out in the framework mirrored the design and development of BitB, recommendations in validating games for health remained focused on randomized trials. Formative research, as part of the HIV GET Tested project, highlights the notion that evaluation through experimental design is not appropriate in all cases, and in particular for behaviour change games where the effectiveness of the game is dependent on a range of external variables for which the game has no influence and where behaviour is not guaranteed to occur at discreet moments in time but instead evolves dynamically as a result of internal and external forces and triggers.

Evaluating game effect

The definition of success, as it relates to health outcomes, not only shapes the methods used to evaluate the game but can also drastically change our view on whether the game has been a success or not. Without a direct causal link between the gameplay, behaviour and health outcome we cannot expect the effect of the game to be consistent across time and the

population. It is however likely that the game will have a direct effect on the user's knowledge and attitudes, and there is evidence of a correlation between knowledge, attitudes and behaviour [129]. There's value in determining the efficacy of the game on knowledge and attitude change as both a proxy measure for game success and to improve the game design. This could involve comparing the game with other health promotion material or using a quasi-experimental design to measure changes in knowledge and attitudes post intervention.

While some regard RCTs as the gold standard in determining causal effect there are few examples of these in practice in the context of games for HIV related behaviour change and a number of limitations to this methodology. In a 2017 publication, researchers conducted an RCT to determine the efficacy of a theory-based digital game to improve sexual health outcomes among minority youth (11-14-years-old) in the USA [130]. They deployed and attention/time control, using 12 commercial games that were devoid of content relevant to the study goals and mirrored the length of gameplay in the experimental group. Eligible participants were enrolled into the intervention or control group in a 1:1 ratio using a computerised single randomisation scheme. The primary outcome evaluated the effect of the game compared with the control games on the delay of initiation of sexual intercourse. Secondary outcomes were sexual attitudes, knowledge and intention. The study found a significant difference in the secondary outcome measures in the experimental group and at 12-months follow up, although given the control group received no sexual health information the finding is not surprising. There was no difference in rates of delaying initiation of sexual intercourse between the experimental and control group. The low rate of initiation of sexual intercourse in the study cohort precluded the researchers from determining the games impact on the primary behavioural outcome. The study design may have benefitted from extending the follow up period or targeting populations at increased risk of sexually transmitted disease, allowing for a potentially greater number of events of sexual initiation. However, evaluation through RCT design to determine the effect of the game on behaviour may not have been appropriate in this case. The study was subject to limitations in evaluating games through experimental design. The first is that experimental design assumes that the 'active ingredient' in the intervention can be isolated from the context, such that a proper control condition can be developed. Gameplay however is intertwined with the user's context. How one user interacts with the game and the psychological processes it invokes will not be the same as it is for another; thus the intervention becomes difficult to properly control for, as the control condition should be equal to the experimental condition in all aspects except the independent variable. In most instances, identifying the independent variable in a behaviour change game is not feasible. The second is that RCTs tend to compare participants at discrete timepoints, whereas behaviour tends to evolve dynamically over time and is dependent on a number of conditions of which the intervention may have no influence.

The narrow focus on the individual through RCT evaluation may leave hidden the game's potential to positively influence the social environment we operate in and subsequently the impact our environment has on our behaviour. By attempting to exclude the context in which we discover, share and play games are we in fact restricting the primary ingredient for effect in behaviour change games when we evaluate them through RCT design?

When the boundaries between the gameplay and context are not clear and the researcher has little control over the context, then case study methodologies may provide a novel approach to exploring the effect of the game on health behaviours or outcomes within its real-life context. Yin, Merriam and Stake are three seminal authors in case study methodologies, and each provide procedures to follow [131]. There are divergences in their definition of case and the processes they advocate for; however, each is potentially suited to games for health research. Stake explains that "for intrinsic case study, case is dominant; the case is of highest importance. For instrumental case study, issue is dominant; we start and end with issues dominant [132]." In the context of games for health development and evaluation, instrumental case study could be deployed to establish the scientific foundations for the game, such as the target audience, outcome objective and theoretical basis. Intrinsic case study could then be deployed to evaluate the game for health, drawing data from multiple sources to capture the case under study in its complexity and entirety. Intrinsic case study in games for health research is likely to benefit from a combination of qualitative and quantitative evidentiary sources, providing both emotional responses and social effects of gameplay, along with objective measures of game uptake and behaviour.

Use of game analytics

The use of game analytics as an evaluation method should also be approached with caution. Game analytics are a potentially important quantitative evidentiary source in games for health evaluation; opening up possibilities in triangulating geographical uptake of the game with routine health service data and tracking player decisions throughout the game as a measure of knowledge and attitude change. While there is clear benefit for utilising game analytics in games for health and behavioural research, compliance with data protection regulation may not equate to users understanding what data is collected, the purpose of the data and how it is handled in order to give voluntary informed consent, which raises ethical concerns. Interviews with BitB users demonstrated that users were unlikely to engage with information on data collected through the game and were willing to give the game access to personal information on their device without understanding the purpose as they believed that not doing so would restrict access to the game. The question on how to properly obtain consent when collecting data using mobile technology has been raised in the literature [133,134]. While researchers focused more broadly on mobile technology and digital media, the issues identified in obtaining consent are relevant to the use of mobile games as data collection tools

in research. At a minimum, when data collected through a mobile game is used for research purposes, users must be given opportunity to voluntarily opt in to providing the data and be given accessible information on the purpose of the study and their rights. The game itself can be used to facilitate the consent process and offers opportunities for multimodal/ multimedia communication to increase the chance of users engaging with and understanding the information. This study showed that meeting required standards in consent and data handling under comprehensive data protection regulation such as the GDPR was not sufficient to ensure users were informed; embedding the consent process into the game as opposed to relying on users accessing an external privacy policy could provide a creative solution to this issue. Attention must also be given to potential security risks, data corruption and privacy breaches within the digital context by ensuring appropriate safeguards are put in place when transferring and storing data. An ethical issue unique to mobiles games is the potential for the game to become a source of coercion or undue influence on the user's decision to participate in the research. This risk can be mitigated against by ensuring access or progress in the game is not reliant on participation in the research and that this is clearly communicated to the user; however, this also undermines the potential of games to encourage participation in research, creating an ethical grey area which developers must navigate. For games targeted at children and adolescents the inherent power imbalance between minors and adult researchers necessitates the need for gatekeeping by a parent/ caregiver; however, this creates an ethical conundrum as both a necessary safety measure and a potential barrier to minors' participation in research. A proposed solution would be to involve both minors and gatekeepers in the design of the consent process.

6.2.4 Application of Games for Health in the Health Development Field

There is strong appeal and demand for digital behaviour change games in the health development field, but the evidence indicates that these games are not the *silver bullets* they are at times portrayed to be. Where a game simply repackages health information in a bid to increase knowledge and change perceptions, its potential to change behaviour lies in the social capital it generates and whether the bounded context surrounding the game is conducive to behaviour change. Behaviour change games should therefore be thought of as tools within a wider health systems strengthening approach to increase health seeking behaviour and improve health outcomes.

The health development field is increasingly looking beyond trial outcomes to a systems-based approach to consider the effectiveness of interventions within the local environment. Health behaviours are the emergent product of cognitive determinants, social field habitus and doxa, structural and economic determinants and policy environments. The complexity of health behaviour precludes the needs for a systems thinking and multidisciplinary approach. Future

research should attempt to understand how a behaviour change game functions within its real-life context and identify factors that mediate its impact on health behaviours or outcomes. Embedding behaviour change games within the health system and using case study methodologies to determine effect represents a new area of research in the game for health field and may help to address the disconnect between the theoretical benefits of behaviour change games and the empirical evidence of their effect on behaviour. Integrating experimental studies to determine the effect of the game on knowledge and attitudes as part of an iterative development process may also help to reduce the time it takes to bring validated games to market and add more value to the data by using it to improve the game design.

As digital games are increasingly brought into the health development space we have a duty to not only ensure the games and the underpinning research meet high standards but are developed ethically through equitable partnerships. This starts by recognising that end users are not the only beneficiaries as the development team gain financial and social capital through their involvement in the project. Just as in other areas of health and scientific research, capacity development strategies can be deployed to strengthen the behavioural science base in local institutes. Training in game design by industry experts can be deployed to increase opportunities and confidence in using local game development companies to build the product. Caution must also be taken not to assume that because vast sums of people globally play and have access to mobile games that this will translate to reaching marginalised populations. Underlying ideologies in games for health could perpetuate digital inequities as we strive for high uptake to the detriment of tailoring the game design and distribution strategy to increase the impact of the game on the lives of the worst off. The literature offers guiding principles applicable to the design, development and implementation of digital health games in developing countries, using a prioritarian approach to ensure the needs of the marginalised are prioritised in the design while attending to issues of power, representation and culture in the health system [135].

The potential negative consequences of gaming must also be considered in future research. Gaming disorder is a recognised health condition by the WHO and defined as “a pattern of gaming behaviour characterized by impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and continuation or escalation of gaming despite the occurrence of negative consequences.” In the Philippines, anecdotal evidence suggested an association between gaming disorders and HIV risk as gamers solicit themselves to fund their gaming habit at internet cafes. This understanding was a significant driving force behind the study and use of a gaming intervention. In cases like this, where the rationale behind the use of a gaming intervention stems from its perceived ability to reach at-risks groups outside formal health promotion, adhering to ethical principles can be challenging when seeking to compete against

commercial games. For example, had we attempted to integrate health messages into popular commercial games in the Philippines we would ultimately be encouraging their use and the associated risk behaviours among a sub-group of the at-risk population; however, this approach may have been more effective in reaching and engaging this at-risk population as opposed to the causal free to play game we proceeded with. Future games for health development and evaluation projects must seek to fully understand the consequences of their intervention beyond the targeted behavioural and pedagogical goals and be conscious of ethical dilemmas in their design, both broadly applicable and unique to the context. Recommended key areas for consideration include techniques to obtain informed consent without undermining access to and the impact of the game, strategies to mitigate against digital inequities, and methods allowing us to understand the positive and negative consequences of a gaming intervention from complex systems and behaviours.

6.3 Limitations

This section will focus on the limitations of the research on game acceptability and effect and puts the findings in the context of the methods. Quantitative methods were predominantly used to supplement and strengthen qualitative findings. For example, qualitative findings on game acceptability were supplemented with objective measures of game use through the game analytics which provided further evidence of the limited appeal of the gameplay. The dominant presence of qualitative methods in the study is reflective of my strengths as a researcher. Quantitative aspects consisted of simple frequency analysis. Quasi-experimental before-and-after design with no concurrent controls were deployed to explore uptake of HIV testing services pre- and post-game launch and changes in knowledge and attitude among game testers pre- and post-gameplay. As a result of this approach, any observed changes could not be categorically attributed to the game. However, the methods were appropriate for the objectives of the study which was to explore the effect of the game on cognitive and social determinants of HIV service use and behaviour as opposed to determining the efficacy of the game.

Qualitative findings were context specific and may not generalize to other contexts or populations. Views from individuals under 18-years-old, rural communities, and those encumbered by HIV related stigma were not captured. Individuals from low socio-economic backgrounds were under-represented in the study. As potential users of the game, their needs and experience of the game were not captured in the findings and therefore can not be generalised to the young key populations in the Philippines as a whole. Recruitment of target game users presented a challenge throughout the study. It was likely that those unwilling to engage in HIV services were also unwilling to engage in HIV related research [136]. When exploring the effect of the game on cognitive and social mediators of HIV service uptake, most

of the recruited participants had previous testing experience, or tested regularly, and were knowledgeable about HIV and their personal risk. While they possessed the demographics of our target audience, they were arguably not target users as the game reaffirmed existing beliefs and practices. This made it difficult to draw conclusions from the data; for example, it was unclear whether the game was limited in its ability to reach and engage target users or if that only appeared to be the case because target users were less willing to be interviewed. Referral by clinic counsellors and participants enabled us to recruit seven participants who had no previous testing experience and were perceived to be at risk of HIV. Within this group there was a diverse range of experiences and reported game influence. As data saturation was not rigorously assessed it is possible that interviews did not capture the full breadth of game experience among target users. Participant characteristics such as education level and average income were captured for each round of interviews and FGDs to ensure findings could be put into the context of the representativeness of the target population sampled.

The accuracy and representativeness of data collected in the study was impacted by missing data and low response rates. The provision of offline gameplay meant that actual game use could not be determined through the game analytics and it is likely that the rate of progression in the game was not as poor as the data reported. The response rate for the clinic survey to measure game use by clients was low (13-34%) which impacted the representativeness of the data. While the low response rate to the clinic survey was identified at an early stage of the data collection process, efforts to improve the response rate through additional training had limited impact.

The approach taken in this study followed the principles of interpretivism and as such is subject to criticism of this ontological position. It is not possible to avoid bias in qualitative analysis as it is by its nature a subjective interpretation of the words and actions of another; however, in evaluating responses to the game it was important to be conscientious of the research team's positionality and ability to interpret qualitative data objectively. Did early playtesting sessions reveal the gameplay was repetitive with limited appeal or was I unconsciously seeking out data to reaffirm my own concerns in the game design? Were issues in the game design overlooked as a result of the research team's vested interest in the games success? Techniques were deployed to mitigate against this potential bias. Qualitative data analysis was conducted with rigour, transcripts were coded to identify emerging themes and the coding framework was developed collaboratively. Disagreements in the coding framework and findings were resolved through discussion until agreement was reached. Effort was made to clearly justify game changes resulting from playtesting sessions with each member of the development team contributing suggested changes to ensure one point of view didn't dominate. Interpretations of the data was discussed with participants to enhance the reliability of the findings. The trustworthiness of the interpretive research could have been further

enhanced by involving and independent panel of experts in the qualitative data analysis process.

The game and associated research activities received strong buy in from local stakeholders, supported by involvement of the Philippines National HIV/AIDS and STI Prevention and Control Program (NASPCP) in project activities and dissemination. Furthermore, HTC service providers were involved in early design workshops for the game (see section 3.3) and were regularly consulted in an informal capacity to gather important insights. This resulted in local stakeholders becoming advocates for the game. The study may have benefited from further research among key stakeholders to explore the feasibility of the game as a health promotion tool and strengthen the games distribution strategy, embedding it in existing or upcoming sexual health programs.

6.3.1 Implications of Grant Funded Research on Game Design

As previously discussed, design choices were driven by both findings from the formative research and the development budget. Each design choice made by the development team was prefixed with a discussion on what was feasible within the pre-determined budget and development timeframe. From the outset of the project, there were signals that suggested the game needed to foster an active community of players and expand beyond health-related content to deliver a disruptive social experience. While we were cognisant of this need, social aspects in BitB were limited due to budgetary constraints. To overcome these constraints, we needed a bigger budget for the game development and marketing; however, it was not possible for us to prove this need as it was theoretical, making it difficult to raise the additional money. Delivering a game within the pre-agreed project timescales was therefore prioritised over delaying the launch of the game to conduct further research into the social context of gameplay to inform the game design.

6.4 Recommendations

This study demonstrated the application of multiple methods to progressively design a behaviour change game and explore its effect on knowledge, attitudes and behaviour. Further research is required to determine the effectiveness of BitB. Additional recommendations for future research and game development studies have been structured by discipline.

Box 6.1 Recommendations for game designers/ developers

- Develop improved methods in participatory game design by offering members of the target audience a credited and compensated role in the development team.
- Enhance the skill base in game design and development in low- and middle-income countries through established capacity strengthening techniques.
- Innovate in social and narrative aspects of mobile game design, ensuring design choices are grounded in theory and the needs of the target audience.
- Improve the use of games as data collection tools through innovation in the consent process.

Box 6.2 Recommendations for public health practitioners and researchers

- Work in partnership with game design and development experts to ensure the content and theoretical basis of the game is sound.
- Use the game to link users to health and support services and conduct research using appropriate methodologies to determine the impact of the game within the health system.
- Enhance the behavioural science base in low- and middle-income countries through established capacity strengthening techniques.
- Integrate gaming tools, when appropriate, into health systems strengthening programmes.
- Ensure equitable access to game-based interventions through use of non-digital platforms and dissemination strategies.

6.5 Conclusion

This study provides valuable insights on the application of behaviour change games in the international health development field. Highlighted in the findings was the importance of the bounded context around the gaming intervention in its potential to effect behaviour. From the composition and dynamics of the game development team to the interplay between the user's social reality and the impact of the game on their behaviour. Narrative and social aspects were identified as important design considerations for behaviour change games. While BitB was evidently successful in influencing cognitive determinants of health seeking behaviour there were missed opportunities and limitations in the game design.

Future application of behaviour change games to other contexts, populations and health challenges must endeavour to incorporate the needs and preferences of the target population in the game design and underpin design choices with evidence and appropriate theory. Embedding the game within new or existing health promotion and health system strengthening programs has the potential to enhance the games effectiveness by addressing both internal and external determinants of health seeking behaviour.

A systems thinking perspective to game evaluation presents an exciting new approach in the games for health field but much work needs to be done to develop robust methods and address the myriad of ethical challenges.

As of January 2021, outputs from the project are still in use. Game analytics report people playing BitB everyday with peaks in uptake and use representing ongoing promotional events for the game. The Philippines' team continues to manage and exploit the Facebook page to engage young key populations in HIV research. The game is recognised and actively promoted by national and local government health programs. Ensuring local ownership of games for health products through equitable partnerships, creative collaboration and capacity building will be integral to the sustainability of these novel interventions.

References

1. Bankoff G, Weekley K. Post-Colonial National Identity in the Philippines. 1st ed. New York: Routledge, Taylor and Francis Group; 2002. [doi: https://doi.org/10.4324/9781315188102]ISBN:9781315188102
2. Tyner JA. The global context of gendered labor migration from the Philippines to the United States. Am Behav Sci 1999;42(4):671–689. [doi: 10.1177/00027649921954417]
3. Semyonov M, Gorodzeisky A. Labor migration, remittances and economic well-being of households in the Philippines. Popul Res Policy Rev 2008;27(5):619–637. [doi: 10.1007/s11113-008-9084-7]
4. Chua K, Cruz K, Qian R, Endo I. Philippines Economic Update: Investing in the Future. Macroecon Trade Invest Glob Pract - World Bank [Internet] 2018;(April). Available from: http://pubdocs.worldbank.org/en/280741523838376587/Philippines-Economic-Update-April-15-2018-final.pdf
5. Cheng CHE, Gipson JD, Perez TL, Cochran SD. Same-Sex Behavior and Health Indicators of Sexually Experienced Filipino Young Adults. Arch Sex Behav [Internet] Springer US; 2016;45(6):1471–1482. PMID:25416159
6. Widmers ED, Treas J, Newcomb R. Attitudes toward Nonmarital Sex in 24 Countries. J Sex Res 1998;35(4):349–358.
7. Kohut A. The Global Divide on Homosexuality: Greater Acceptance in More Secular and Affluent Countries. Washington, DC Pew Res Cent 2013;1–26.
8. Bernardo ABI. Exploring Social Cognitive Dimensions of Sexual Prejudice in Filipinos. Philipp J Psychol 2016;46(April):19–48.
9. Enacting an Anti-Discrimination Based on Sexual Orientation and Gender Identity Law: Policy Brief. Philipp Comm Women.
10. Power H, Ocampo R, Matar L. Philippines: UN action offered a glimpse of hope and justice [Internet]. Amnesty Int. 2019 [cited 2019 Sep 10]. Available from: https://www.amnesty.org/en/latest/news/2019/08/philippines-un-action-offered-glimpse-hope-justice/
11. Jr RM, Jr JNS, Poblete R. HIV / AIDS In the Philippines. Aids 2004;43–52.
12. Eugenio M. CACCAM J. Fighting a Rising Tide: The Response to AIDs in East Asia “The Philippines.” Yamamoto T, Itoh S, editors. Japan Center for

International Exchange; 2006. ISBN:0791080242
13. Kageyama S, Agdamag DMD, Alesna ET, Abellanosa-Tac-An IP, Corpuz AC, Telan EFO, Que ER, Leaño PSA, Jereza LD, Emphasis YEE, Prasetyo AA, Tanimoto T, Ichimura H. Tracking the entry routes of hepatitis C virus as a surrogate of HIV in an HIV-low prevalence country, the Philippines. J Med Virol 2009;81(7):1157–1162. PMID:21187455
14. Farr AC, Wilson DP. An HIV epidemic is ready to emerge in the Philippines. J Int AIDS Soc 2010;13(1):1–9. PMID:20409346
15. HAIN. HIV and AIDS COUNTRY PROFILE. 2005.
16. Saniel OP, De los Reyes SJ. Prevalence of risky behaviours and determinants of multiple sex partnerships among male Filipino seafarers. Int Marit Health [Internet] 2010;62(4):215–223. PMID:21348015
17. Yanase Y, Ohida T, Kaneita Y, Agdamag DMD, Leaño PS a., Gill CJ. The prevalence of HIV, HBV and HCV among Filipino blood donors and overseas work visa applicants. Bull World Health Organ 2007;85(2):131–137. PMID:17308734
18. Ruxrungtham K, Brown T, Phanuphak P, Red T. Seminar HIV / AIDS in Asia. Lancet 2004;364:69–82.
19. Salvana EM. The Philippine HIV/AIDS Epidemic: A Call to Arms. Acta Med Philipp [Internet] 2010;4(1):2009–2011. Available from: http://actamedicaphilippina.com.ph/sites/default/files/hiv_aids.pdf
20. Carcamo C, Fernandes T, Saniel O. ASSESSMENT OF THE PHILIPPINES NATIONAL HIV/AIDS SENTINEL SURVEILLANCE SYSTEM. USAID. 2005.
21. UNIADS. PRESS RELEASE : UNAIDS report indicates new HIV infections in the Philippines have doubled in the past 6 years. 2017;8–11. Available from: https://unaids-ap.org/2017/08/01/press-statement-unaids-report-indicates-new-hiv-infections-in-the-philippines-have-doubled-in-the-past-6-years/#more-2870
22. Ross AGP, Ditangco R a, Belimac JG, Olveda RM, Mercado ES, Chau TNP, Crowe SM. International Journal of Infectious Diseases The dire sexual health crisis among MSM in the Philippines : an exploding HIV epidemic in the absence of essential health services. Int J Infect Dis [Internet] International Society for Infectious Diseases; 2016;37(2015):6–8. [doi: 10.1016/j.ijid.2015.06.001]
23. Restar A, Nguyen M, Nguyen K, Adia A, Nazareno J, Yoshioka E, Hernandez

L, Operario D. Trends and emerging directions in HIV risk and prevention research in the Philippines: A systematic review of the literature. PLoS One 2018;13(12):1–21. [doi: 10.1371/journal.pone.0207663]

24. Cousins S. The fastest growing HIV epidemic in the western Pacific. Lancet HIV [Internet] Elsevier Ltd; 2018;5(8):e412–e413. [doi: 10.1016/S2352-3018(18)30182-6]
25. Telan EFO, Samonte GMJ, Palaypayon N, Abellanosa-Tac-An IP, Leaño PSA, Tsuneki A, Kageyama S. Possible HIV transmission modes among at-risk groups at an early epidemic stage in the Philippines. J Med Virol 2013;85(12):2057–2064. PMID:23959846
26. Gangcuangco LM a, Tan ML, Berba RP. Prevalence and risk factors for HIV infection among men having sex with men in Metro Manila, Philippines. Southeast Asian J Trop Med Public Health 2013;44(5):810–817. PMID:24437316
27. Department of Health Epidemiolgy Bureau. June 2018 HIV / AIDS and ART Registry of the Philippines [Internet]. Repub Philipp. 2018. Available from: https://www.aidsdatahub.org/resource/hiv-aids-and-art-registry-philippines-jun-2018
28. HAIN. Taking Stock: A Survey of AIDs Responses for MSM and TG Populations. 2013.
29. Ryan Cuevas PF, Calalang CF, Joshua Delos Reyes DA, Marie Antoinette Rosete AL. The Impact of Decentralization of the Philippines' Public Health System on Health Outcomes. Int J Adv Res Technol [Internet] 2017;6(2). Available from: http://www.ijoart.org/docs/The-Impact-of-Decentralization-of-the-Philippines-Public-Health-System-on-Health-Outcomes.pdf
30. National AIDS and STI Prevention and Control Program Philippines Department of Health. HIV Prevention and Control Costed Operational Plan 2018 - 2020. 2017.
31. Gangcuangco LMA. HIV crisis in the Philippines: urgent actions needed. Lancet Public Heal [Internet] The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY-NC-ND 4.0 license; 2019;4(2):e84. [doi: 10.1016/S2468-2667(18)30265-2]
32. PhilStar. No shortage of HIV drugs, says DOH [Internet]. 2019 [cited 2019 Sep 13]. Available from:

https://www.philstar.com/headlines/2019/01/11/1884213/no-shortage-hiv-drugs-says-doh

33. Philippines Department of Health. Revised Policies and Guidelines on the Use of ART Among People Living with HIV and HIV-exposed Infants [Internet]. 2018. Available from: https://www.scribd.com/document/406458483/DOH-AO-No-2018-0024-Revised-Policies-and-Guidelines-of-ART
34. Melgar JLD, Melgar AR, Festin MPR, Hoopes AJ. Assessment of country policies affecting reproductive health for adolescents in the Philippines. Reproductive Health; 2018;1–13.
35. Philippines Department of Health Epidemiolgy Bureau. Integrated HIV behavioural and serologic surveillance: 2015 fact sheet [Internet]. 2015. Available from: https://www.doh.gov.ph/sites/default/files/publications/Philippines_2015_IHBSS_Fact_Sheets_Nov2017_22JUN2016.pdf [WebCite Cache Failed]
36. Lucea MB, Hindin MJ, Gultiano S, Kub J, Rose L. The context of condom use among young adults in the Philippines: implications for HIV prevention. Health Care Women Int [Internet] 2013;34(3–4):227–248. [doi: 10.1080/07399332.2012.721414]
37. Human Rights Watch. The Philippines Unprotected: Sex, Condoms, and the Human Right to Health [Internet]. Volume 16,. Human Rights Watch; 2004. Available from: https://books.google.co.uk/books?id=FLjF6KkXWnYC
38. Torres J. Philippine govt stops condom distribution to students [Internet]. UCA News. 2017 [cited 2019 Sep 24]. Available from: https://www.ucanews.com/news/philippine-govt-stops-condom-distribution-to-students/80428
39. McGonigal J. Reality is broken : why games make us better and how they can change the world. Penguin Group; 2011. ISBN:9780143120612
40. Lieberman D. Dance games and other exergames: What the research says [Internet]. Unpubl report, Univ California, St Barbar Available http//www comm ucsb edu/faculty/lieberman/exergames htm Accessed April. 2006. Available from: http://www.comm.ucsb.edu/faculty/lieberman/exergames.htm%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Dance+Games+and+Other+Exergames:+What+the+Research+Says#0

41. Akl E, Kairouz V, Sackett K, Erdley W, Mustafa R, Fiander R, Gabriel C, Schünemann H. Educational Games for Health Professionals (Review). Cochrane Database Syst Rev 2013;(3). [doi: 10.1002/14651858.CD006411.pub4.www.cochranelibrary.com]
42. Li A, Montaño Z, Chen VJ, Gold JI. Virtual reality and pain management: current trends and future directions. Pain Manag [Internet] 2011;1(2):147–157. [doi: 10.2217/pmt.10.15.Virtual]
43. DeSmet A, Ryckeghem D, Compernolle S, Baranowski T, Thompson D, Crombez G. A meta-analysis of serious digital games for healthy lifestyle promotion. Prev Med [Internet] 2014;69. [doi: 10.1016/j.ypmed.2014.08.026]
44. Prensky M. Fun , Play and Games : What Makes Games Engaging. Digit Game-Based Learn [Internet] 2001;1–31. PMID:19134487
45. Shen F, Han J (Ashley). Effectiveness of entertainment education in communicating health information: a systematic review. Asian J Commun [Internet] Taylor & Francis; 2014;24(6):605–616. [doi: 10.1080/01292986.2014.927895]
46. Kort YAW De, Poels K, Ijsselsteijn WA. Digital Games as Social Presence Technology : Development of the Social Presence in Gaming Questionnaire (SPGQ). Presence 2007;(October):1–9. PMID:15644401
47. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implement Sci [Internet] 2011;6(1):42. [doi: 10.1186/1748-5908-6-42]
48. Ofreneo MAP, Philippines Department of Health Epidemiology Bureau. Qualitative Study on the Drivers and Barriers to Condom Use, HIV Testing, and Access to Social Hygiene Clinic Services among Males who have Sex with Males [Internet]. Epidemiol Bur Dep Heal Philipp. 2015. Available from: https://www.doh.gov.ph/sites/default/files/publications/2015_Qualitative_Study_Drivers_Barriers_Condom_Use.pdf
49. Hightow-Weidman LB, Muessig KE, Bauermeister JA, LeGrand S, Fiellin LE. The future of digital games for HIV prevention and care. Curr Opin HIV AIDS [Internet] United States; 2017;12(5):501–507. [doi: https://dx.doi.org/10.1097/COH.0000000000000399]
50. Bandura A. Health promotion by social cognitive means. Health Educ Behav 2004;31(2):143–164. PMID:15090118

51. Kato PM, Cole SW, Bradlyn AS, Pollock BH. A video game improves behavioral outcomes in adolescents and young adults with cancer: a randomized trial. Pediatrics [Internet] 2008;122. [doi: 10.1542/peds.2007-3134]
52. Koirala S, Deuba K, Nampaisan O, Marrone G, Ekstrom AM, group C-S. Facilitators and barriers for retention in HIV care between testing and treatment in Asia-A study in Bangladesh, Indonesia, Lao, Nepal, Pakistan, Philippines and Vietnam. PLoS One [Internet] United States; 2017;12(5):e0176914. [doi: https://dx.doi.org/10.1371/journal.pone.0176914]
53. Johnson RB, Onwuegbuzie AJ. Mixed Methods Research: A Research Paradigm Whose Time Has Come. Educ Res [Internet] American Educational Research Association; 2004 Oct 1;33(7):14–26. [doi: 10.3102/0013189X033007014]
54. UN Office for the Coordination of Humanitarian Affairs. Philippines: National Capital Region (NCR) Profile (4 Dec 2015) [Internet]. [cited 2019 Sep 24]. Available from: https://reliefweb.int/report/philippines/philippines-national-capital-region-ncr-profile-4-dec-2015
55. Philippines Department of Health Epidemiolgy Bureau. HIV / AIDS and ART Registry of the Philippines [Internet]. 2018. Available from: http://www.aidsdatahub.org/hivaids-and-art-registry-philippines-march-2018-epidemiology-bureau-department-health-2018 [WebCite Cache Failed]
56. UN Office for the Coordination of Humanitarian Affairs. Philippines: Region XI (Davao Region) Profile (2 Dec 2015) [Internet]. 2015 [cited 2019 Sep 24]. Available from: https://reliefweb.int/report/philippines/philippines-region-xi-davao-region-profile-2-dec-2015
57. Philippines Department of Health. Policies and Guidelines in the Conduct of HIV Testing Services in Health Facilities [Internet]. 2017. Available from: https://advocatehiv.files.wordpress.com/2017/09/2017-doh_ao_2017-0019.pdf
58. Hemingway C, Baja E, Dalmacion G, Medina P, Guevara E, TR S, Dacombe R, Dormann C, Taegtmeyer M. Development of a Mobile Game to Influence Behaviour Determinants of HIV Service Uptake Among Key Populations in the Philippines: User-centred Design Process. JMIR Serious Games (forthcoming/in Press [Internet] 2019; [doi: 10.2196/13695]
59. Brian Bourke. Positionality: Reflecting on the Research Process. Qual Rep 2014;19(33):1–9.

60. Philippines Department of Health Epidemiology Bureau. The state of the Philippine HIV epidemic 2016: facing challenges forging solutions [Internet]. 2016. Available from: https://www.doh.gov.ph/sites/default/files/publications/publication__nonSerials_State of HIV Epidemic in the Philippines.pdf [WebCite Cache Failed]
61. United Nations Programme on HIV/AIDS. UNAIDS Data 2017. Program HIV/AIDS [Internet] 2017;1–248. [doi: 978-92-9173-945-5]
62. UNAIDS. The need for routine viral load testing. 2016.
63. Bugarin R. ART Chronicles: CD4 Count and Viral Load [Internet]. LoveYourself. 2018 [cited 2019 Jul 25]. Available from: http://www.loveyourself.ph/2018/10/art-chronicles-cd4-count-and-viral-load.html
64. Mendoza J. PhilHealth beneft package for people with HIV under review [Internet]. 2016. Available from: https://iamjoemmendoza.wordpress.com/2016/04/27/philhealth-benefit-package-for-people-with-hiv-under-review/
65. OutrageMag. RITM to stop giving CD4 count to PLHIVs on treatment [Internet]. 2016 [cited 2019 Jul 25]. Available from: https://outragemag.com/ritm-to-stop-giving-cd4-count-to-plhivs-on-treatment/
66. MOH Philippine. 5th AIDS medium term plan 2011-2016 Philippine strategic plan on HIV and AIDS. 2011;98. Available from: http://www.aidsdatahub.org/dmdocuments/Philippines_NSP_2011-15.pdf
67. UNAIDS. Country Progress Report: Philippines [Internet]. 2018. Available from: https://www.ifc.org/wps/wcm/connect/1152903e-a46b-43a6-b9f1-ea862e7d70ab/SBN+Country+Progress+Report+-+Vietnam.pdf?MOD=AJPERES
68. Canoy N a, Ofreneo MAP. Struggling to care : A discursive-material analysis of negotiating agency among HIV-positive MSM. Heal An Interdiscip J Soc Study Heal Illn Med 2016;1–20. PMID:26851265
69. Ajzen I, Fishbein M. Understanding attitudes and predicting social behavior. Englewood Cliffs, N.J.: Prentice-Hall; 1980. ISBN:0139364439 9780139364433 0139364358 9780139364358
70. Fischer R, Ferreira MC, Assmar E, Redford P, Harb C, Glazer S, Cheng B-S, Jiang D-Y, Wong CC, Kumar N, Kärtner J, Hofer J, Achoui M. Individualism-

collectivism as Descriptive Norms: Development of a Subjective Norm Approach to Culture Measurement. J Cross Cult Psychol [Internet] SAGE Publications Inc; 2009 Mar 1;40(2):187–213. [doi: 10.1177/0022022109332738]

71. Musheke M, Ntalasha H, Gari S, Mckenzie O, Bond V, Martin-Hilber A, Merten S. A systematic review of qualitative findings on factors enabling and deterring uptake of HIV testing in Sub-Saharan Africa. BMC Public Health [Internet] 2013;13(1):220. [doi: 10.1186/1471-2458-13-220]
72. Lorenc T, Marrero-Guillamón I, Llewellyn A, Aggleton P, Cooper C, Lehmann A, Lindsay C. HIV testing among men who have sex with men (MSM): systematic review of qualitative evidence. Health Educ Res [Internet] 2011 Aug 26;26(5):834–846. [doi: 10.1093/her/cyr064]
73. Deblonde J, De Koker P, Hamers FF, Fontaine J, Luchters S, Temmerman M. Barriers to HIV testing in Europe: a systematic review. Eur J Public Health [Internet] 2010 Feb 1;20(4):422–432. [doi: 10.1093/eurpub/ckp231]
74. Noblit GW, Hare RD, Hare RW, Sage Publications inc. Meta-Ethnography: Synthesizing Qualitative Studies [Internet]. SAGE Publications; 1988. Available from: https://books.google.co.uk/books?id=fQQb4FP4NSgCISBN:9780803930230
75. France EF, Uny I, Ring N, Turley RL, Maxwell M, Duncan EAS, Jepson RG, Roberts RJ, Noyes J. A methodological systematic review of meta-ethnography conduct to articulate the complex analytical phases. BMC Med Res Methodol [Internet] 2019;19(1):35. [doi: 10.1186/s12874-019-0670-7]
76. Smith J, Firth J. Qualitative data analysis: application of the framework approach. Nurse Res 2011;18(2):52–62. [doi: 10.7748/nr2011.01.18.2.52.c8284]
77. World Health Organization. HIV and Adolescents: Guidance for HIV Testing and Counselling and Care for Adolescents Living with HIV: Recommendations for a Public Health Approach and Considerations for Policy-Makers and Managers. Geneva: Adolescent HIV testing and counselling: a revie [Internet]. 2013. Available from: https://www.ncbi.nlm.nih.gov/books/NBK217943/
78. Lu AS, Baranowski T, Thompson D, Buday R. Story Immersion of Videogames for Youth Health Promotion: A Review of Literature. Games Health J [Internet] Mary Ann Liebert, Inc.; 2012 Jun;1(3):199–204. [doi: 10.1089/g4h.2011.0012]

79. Green MC, Brock TC. The role of transportation in the persuasiveness of public narratives. J Pers Soc Psychol United States; 2000 Nov;79(5):701–721. PMID:11079236
80. Conner M. Cognitive Determinants of Health Behavior BT - Handbook of Behavioral Medicine: Methods and Applications. In: Steptoe A, editor. New York, NY: Springer New York; 2010. p. 19–30. [doi: 10.1007/978-0-387-09488-5_2]
81. Gladwell M. The tipping point : how little things can make a big difference [Internet]. First Back. Boston : Back Bay Books, 2002.; 2002. Available from: https://search.library.wisc.edu/catalog/999965324602121ISBN:0349113467
82. Lope RP De, Medina-Medina N, Soldado RM, García AM, Gutiérrez-Vela FL. Designing educational games: Key elements and methodological approach. 2017 9th Int Conf Virtual Worlds Games Serious Appl 2017. p. 63–70. [doi: 10.1109/VS-GAMES.2017.8055812]
83. Arnab S, Lim T, Carvalho MB, Bellotti F, de Freitas S, Louchart S, Suttie N, Berta R, De Gloria A. Mapping learning and game mechanics for serious games analysis. Br J Educ Technol [Internet] John Wiley & Sons, Ltd; 2015 Mar 1;46(2):391–411. [doi: 10.1111/bjet.12113]
84. Ahmad M, Rahim L, Arshad NI. A review of educational games design frameworks: An analysis from software engineering. 2014 Int Conf Comput Inf Sci 2014. p. 1–6. [doi: 10.1109/ICCOINS.2014.6868452]
85. Amory A. Game object model version II: A theoretical framework for educational game development. Educ Technol Res Dev 2007 Feb 1;55:51–77. [doi: 10.1007/s11423-006-9001-x]
86. Montgomery SB, Joseph JG, Becker MH, Ostrow DG, Kessler RC, Kirscht JP. The Health Belief Model in understanding compliance with preventive recommendations for AIDS: How useful? AIDS Educ Prev. US: Guilford Publications; 1989. p. 303–323.
87. Bandura A. Social Cognitive Theory and Exercise of Control over HIV Infection. In: DiClemente RJ, Peterson JL, editors. Prev AIDS Theor Methods Behav Interv [Internet] Boston, MA: Springer US; 1994. p. 25–59. [doi: 10.1007/978-1-4899-1193-3_3]
88. Fisher JD, Fisher WA. Changing AIDS-risk behavior. Psychol Bull United States; 1992 May;111(3):455–474. PMID:1594721

89. Choi SH, Duffy SA. Analysis of Health Behavior Theories for Clustering of Health Behaviors. J Addict Nurs United States; 2017;28(4):203–209. PMID:29200047
90. Fishbein M. A reasoned action approach to health promotion. Med Decis Making [Internet] 2008/11/17. 2008;28(6):834–844. [doi: 10.1177/0272989X08326092]
91. Desmet A, Shegog R, Van Ryckeghem D, Crombez G, De Bourdeaudhuij I. A Systematic Review and Meta-analysis of Interventions for Sexual Health Promotion Involving Serious Digital Games. Games Health J 2015;4(2):78–90. [doi: 10.1089/g4h.2014.0110]
92. Peng W. Design and Evaluation of a Computer Game to Promote a Healthy Diet for Young Adults. Health Commun 2009 Apr 1;24:115–127. [doi: 10.1080/10410230802676490]
93. Silk KJ, Sherry J, Winn B, Keesecker N, Horodynski MA, Sayir A. Increasing nutrition literacy: testing the effectiveness of print, web site, and game modalities. J Nutr Educ Behav United States; 2008;40(1):3–10. PMID:18174098
94. Bandura A. Health promotion by social cognitive means. Heal Educ Behav [Internet] 2004;31. [doi: 10.1177/1090198104263660]
95. Baranowski T, Buday R, Thompson D, Lyons EJ, Lu AS, Baranowski J. Developing Games for Health Behavior Change: Getting Started. Games Health J [Internet] Mary Ann Liebert, Inc.; 2013 Aug;2(4):183–190. [doi: 10.1089/g4h.2013.0048]
96. Thompson D. Designing serious video games for health behavior change: current status and future directions. J Diabetes Sci Technol [Internet] Diabetes Technology Society; 2012 Jul 1;6(4):807–811. [doi: 10.1177/193229681200600411]
97. Arnab S, Brown K, Clarke S, Dunwell I, Lim T, Suttie N, Louchart S, Hendrix M, de Freitas S. The development approach of a pedagogically-driven serious game to support Relationship and Sex Education (RSE) within a classroom setting. Comput Educ [Internet] 2013;69:15–30. [doi: https://doi.org/10.1016/j.compedu.2013.06.013]
98. Shegog R, Peskin MF, Markham C, Thiel M, Karny E, Addy RC, Johnson KA, Tortolero S. It's Your Game-Tech: Toward Sexual Health in the Digital Age.

Creat Educ [Internet] United States; 2014;5(15):1428–1447. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=medp&NEWS=N&AN=25705561

99. DeSmet A, Thompson D, Baranowski T, Palmeira A, Verloigne M, De Bourdeaudhuij I. Is Participatory Design Associated with the Effectiveness of Serious Digital Games for Healthy Lifestyle Promotion? A Meta-Analysis. Eysenbach G, editor. J Med Internet Res [Internet] Toronto, Canada: JMIR Publications Inc.; 2016 Apr 29;18(4):e94. [doi: 10.2196/jmir.4444]
100. Baranowski T, Lieberman D, Buday R, Peng W, Zimmerli L, Wiederhold B, Kato P. Videogame Mechanics in Games for Health. Games Health J 2013 Aug 1;2:194–204. [doi: 10.1089/g4h.2013.0617]
101. Baranowski MT, Lu AS, Buday R, Lyons EJ, Schell J, Russoniello C. Stories in Games for Health: More Pros or Cons? Games Health J [Internet] 2013/09/27. Mary Ann Liebert, Inc.; 2013 Oct;2(5):256–263. [doi: 10.1089/g4h.2013.0052]
102. Lewin K. Resolving social conflicts and field theory in social science. Resolv Soc conflicts F theory Soc Sci. Washington, DC, US: American Psychological Association; 1997. p. v, 422–v, 422. [doi: 10.1037/10269-000]
103. Rittel HWJ, Webber MM. Dilemmas in a general theory of planning. Policy Sci 1973;4(2):155–169. [doi: 10.1007/BF01405730]
104. Pagulayan RJ, Keeker K, Fuller T, Wixon D, Romero RL, Gunn D V. User-centered Design in Games. Hum Comput Interact Handb [Internet] L. Erlbaum Associates Inc. Hillsdale, NJ, USA; 2003. p. 883–906. Available from: http://msgamesresearch.com/Documents/HCI_Handbook_Chapter.pdf
105. Giacomin J. What is human centred design? Des J 2014;17(4):606–623. [doi: 10.2752/175630614X14056185480186]
106. Mayer I, Bekebrede G, Harteveld C, Warmelink H, Zhou Q, Van Ruijven T, Lo J, Kortmann R, Wenzler I. The research and evaluation of serious games: Toward a comprehensive methodology. Br J Educ Technol 2014;45(3):502–527. [doi: 10.1111/bjet.12067]
107. Mirza-Babaei P, Moosajee N, Drenikow B. Playtesting for indie Studios. Acad 2016 - Proc 20th Int Acad Mindtrek Conf 2016;(October):366–374. [doi: 10.1145/2994310.2994364]
108. Reinius M, Wettergren L, Wiklander M, Svedhem V, Ekström AM, Eriksson LE. Development of a 12-item short version of the HIV stigma scale. Health Qual

Life Outcomes [Internet] BioMed Central; 2017 May 30;15(1):115. [doi: 10.1186/s12955-017-0691-z]

109. Korhonen H, Koivisto EMI. Playability heuristics for mobile multi-player games. Proc 2nd Int Conf Digit Interact media Entertain arts - DIMEA '07 [Internet] 2007;28. PMID:13657
110. Sekhon M, Cartwright M, Francis JJ. Acceptability of healthcare interventions: an overview of reviews and development of a theoretical framework. BMC Health Serv Res [Internet] BMC Health Services Research; 2017;17(1):88. PMID:28126032
111. Goddard M. Viewpoint: The EU general data protection regulation (GDPR): European regulation that has a global impact. Int J Mark Res 2017;59(6):703–706. [doi: 10.2501/IJMR-2017-050]
112. Google Trends [Internet]. [cited 2020 Jan 15]. Available from: https://trends.google.com/trends/explore?date=2016-12-04 2018-09-04&geo=PH&q=HIV test
113. Department of Health Epidemiolgy Bureau. December 2017 HIV / AIDS and ART Registry of the Philippines [Internet]. Repub Philipp. 2017. Available from: https://www.aidsdatahub.org/resource/hiv-aids-and-art-registry-philippines-dec-2017
114. Smith SP, Blackmore K, Nesbitt K. A Meta-Analysis of Data Collection in Serious Games Research BT - Serious Games Analytics: Methodologies for Performance Measurement, Assessment, and Improvement. In: Loh CS, Sheng Y, Ifenthaler D, editors. Cham: Springer International Publishing; 2015. p. 31–55. [doi: 10.1007/978-3-319-05834-4_2]
115. Cate FH. The failure of fair information practice principles: Consumer protection in the age of the information economy. J.K. Winn. Ashgate Publishing; 2006.
116. Thomas DR. A General Inductive Approach for Analyzing Qualitative Evaluation Data. Am J Eval 2006;27(2):237–246. [doi: 10.1177/1098214005283748]
117. Yin RK. How to do better case studies. In: Bickman L, Rog DJ, editors. SAGE Handb Appl Soc Res methods illustrate. SAGE; 2009. p. 275–278.
118. Stryker S, Burke PJ. The Past, Present, and Future of an Identity Theory. Soc Psychol Q [Internet] [Sage Publications, Inc., American Sociological

Association]; 2000 Dec 16;63(4):284–297. [doi: 10.2307/2695840]
119. Squire K. From Content to Context: Videogames as Designed Experience. Educ Res [Internet] American Educational Research Association; 2006 Nov 1;35(8):19–29. [doi: 10.3102/0013189X035008019]
120. Ducheneaut N, Yee N, Nickell E, Moore RJ. “Alone Together?”: Exploring the Social Dynamics of Massively Multiplayer Online Games. Proc SIGCHI Conf Hum Factors Comput Syst [Internet] New York, NY, USA: Association for Computing Machinery; 2006. p. 407–416. Available from: https://doi.org/10.1145/1124772.1124834
121. Lara-de Leon KJ. A STUDY OF INTERNET CAFÉS: IDENTITY, FREEDOM AND COMMUNICATIVE EXTENSION. Philipp Sociol Rev [Internet] Philippine Sociological Society; 2007 Jul 22;55:37–49. Available from: http://www.jstor.org/stable/23898244
122. Cao B, Gupta S, Wang J, Hightow-Weidman LB, Muessig KE, Tang W, Pan S, Pendse R, Tucker JD. Social Media Interventions to Promote HIV Testing, Linkage, Adherence, and Retention: Systematic Review and Meta-Analysis. J Med Internet Res [Internet] 2017;19(11):e394. [doi: 10.2196/jmir.7997]
123. Fisher J. Digital games for international development: A field theory perspective. Int Commun Gaz [Internet] SAGE Publications Ltd; 2018 Nov 29;81(6–8):707–726. [doi: 10.1177/1748048518814358]
124. Sharifzadeh N, Kharrazi H, Nazari E, Tabesh H, Khodabandeh ME, Heidari S, Tara M. Health education serious games targeting health care providers, patients, and public health users: Scoping review. J Med Internet Res 2020;22(3):1–16. [doi: 10.2196/13459]
125. Verschueren S, Buffel C, Vander Stichele G. Developing Theory-Driven, Evidence-Based Serious Games for Health: Framework Based on Research Community Insights. JMIR serious games [Internet] JMIR Publications; 2019 May 2;7(2):e11565–e11565. [doi: 10.2196/11565]
126. Sicart M. Defining Game Mechanics. Int J Comput Game Res 2008;8(2):19–52. [doi: 10.1201/9781482267334-9]
127. Gittell JH. Relational Coordination: Guidelines for Theory, Measurement and Analysis. Inf Syst Res 2009;565–585.
128. Bergen N, Labonté R. “Everything Is Perfect, and We Have No Problems”: Detecting and Limiting Social Desirability Bias in Qualitative Research. Qual

Health Res [Internet] SAGE Publications Inc; 2019 Dec 13;30(5):783–792. [doi: 10.1177/1049732319889354]

129. Evangeli M, Ferris K, Kenney NM, Baker LLE, Jones B, Wroe AL. A systematic review of psychological correlates of HIV testing intention. AIDS Care [Internet] Taylor & Francis; 2018 Jan 2;30(1):18–26. [doi: 10.1080/09540121.2017.1344351]
130. Fiellin LE, Hieftje KD, Pendergrass TM, Kyriakides TC, Duncan LR, Dziura JD, Sawyer BG, Mayes L, Crusto CA, Forsyth BW, al. et. Video Game Intervention for Sexual Risk Reduction in Minority Adolescents: randomized Controlled Trial. J Med internet Res [Internet] 2017;19(9):e314. [doi: 10.2196/jmir.8148]
131. Yazan B. Three Approaches to Case Study Methods in Education: Yin, Merriam, and Stake. Qual Rep [Internet] 2015;20(2):134–152. Available from: http://www.nova.edu/ssss/QR/QR20/2/yazan1.pdf
132. Stake RE. The art of case study research. art case study Res. Thousand Oaks, CA, US: Sage Publications, Inc; 1995. ISBN:0-8039-5766-1 (Hardcover); 0-8039-5767-X (Paperback)
133. Facca D, Smith MJ, Shelley J, Lizotte D, Donelle L. Exploring the ethical issues in research using digital data collection strategies with minors: A scoping review. PLoS One [Internet] Public Library of Science; 2020 Aug 27;15(8):e0237875–e0237875. [doi: 10.1371/journal.pone.0237875]
134. Ali J, Labrique AB, Gionfriddo K, Pariyo G, Gibson DG, Pratt B, Deutsch-Feldman M, Hyder AA. Ethics Considerations in Global Mobile Phone-Based Surveys of Noncommunicable Diseases: A Conceptual Exploration. J Med Internet Res [Internet] 2017;19(5):e110. [doi: 10.2196/jmir.7326]
135. Winters N, Venkatapuram S, Geniets A, Wynne-Bannister E. Prioritarian principles for digital health in low resource settings. J Med Ethics [Internet] 2020 Apr 1;46(4):259 LP – 264. [doi: 10.1136/medethics-2019-105468]
136. Shaghaghi A, Bhopal RS, Sheikh A. Approaches to Recruiting “Hard-To-Reach” Populations into Re-search: A Review of the Literature. Heal Promot Perspect [Internet] Tabriz University of Medical Sciences; 2011 Dec 20;1(2):86–94. [doi: 10.5681/hpp.2011.009]

Glossary

Term	Definition
Behaviour change theory	Attempts to explain why human behaviours change, citing environmental and personal factors
Behaviour determinants	Environmental and personal factors that are strongly associated with human behaviour
Beta game build	A version of a game in development where all the content has been created and implemented but changes and improvements are still expected to be made
Enemy units	Simulated opponents that the player must defeat to complete the level
eSports	A multiplayer video game played competitively by professional gamers for spectators
Event data	Information about a change or action occurring within a game at a point in time
Game analytics	Quantitative measures used to track events within a game to generate insights to inform the design or distribution of the game
Game design document	Highly descriptive living software design document to organize efforts within a development team
Game mechanics	Coded objects invoked by agents which facilitate interaction with the game state by the player
Game-based learning theory	Attempts to explain how learning is achieved through gameplay to inform design and evaluation
HIV care cascade	A system used to gauge the number of people living with HIV and if they are receiving the care they need
Human scatter graph	A physical activity used to gauge group perceptions
Key populations	Populations which face much higher rates of HIV and AIDS than the general population
Learning objective - game design map	A design tool which enables developers to connect learning and gameplay aspects
Match-3 RPG	A popular mobile game genre where players connect matching icons on a puzzle board integrated with elements of role-playing games
Onboarding	Content in the game which teaches the player the controls and rules of the game
Pachinko	A type of mechanical arcade game originating in Japan which resembles a vertical pinball machine - balls enter the playing field which is populated by numerous brass pegs with cups at the bottom – the object of the game is to catch as many balls as possible in the high scoring cups
Participatory design	An approach to game design attempting to actively involve stakeholders at multiple stages in the design process, from problem definition to design solutions
Playability heuristics	A set of qualities by which a game's engagement and usability can be assessed
Playability violation	A record of user experience which demonstrates a flaw in the game's engagement and usability
Playtesting	A set of methods to measure and analyse player behaviour and emotive response during gameplay
Prototype testing	A stage in the game development process where player behaviour and emotive response is measured using an incomplete version of the game

Serious games	Where the purpose of the game expands beyond entertainment
Silver bullets	Something that instantly solves a long-standing problem or a simple solution to a complicated problem
Telemetry data	One of the fundamental terms in game analytics, describing the collection of data over a distance.
UNAIDS 90-90-90 target	In order to achieve an AIDS-free generation, the UNAIDS set an ambitious target code named 90-90-90, which aims to ensure that 90% of all people living with HIV will know their status, 90% of all people diagnosed will receive sustained antiretroviral therapy (ART), and 90% of all people receiving ART will have viral suppression

Appendices

Appendix 1: Chapter 2 Interview Topic Guide

I. Key Informant Interview – Target Group: MSM HTC Service User

Consent: Ensure to take the participant through consent form and explain the study. Make sure to remind the participant that all information will be held anonymously and securely at all times.

Please ensure the participant meets the following criteria before proceeding with the interview.

Inclusion Criteria

1. Cis-gender male or transgender woman
2. Admits to having sex with men
3. Must be a resident of the Philippines
4. Has attended a clinic for HTC services in the Philippines in the past 2 years*

*if the participant states they have not attended a clinic for HTC services in the Philippines in the past 2 years, and they do meet criteria 1 to 3 then proceed with the MSM HTC non-service user interview guide.

Demographic Information

- Age
- Sexual orientation
- Marital/relationship status
- Religion
- Education level
- Employment status and type of employment (e.g. employed full time, self-employed, un-employed etc.)

Knowledge and perception about HIV

- Can you describe what HIV is?
- What kind of information have you received regarding HIV? Who provided the information and when?
- How can HIV be transmitted?
- Who do you think is at increased risk of transmission?
- Do you know anyone that is HIV positive? If yes, do you know how this person contracted HIV? (Please request that they do not disclose the name of any known persons before asking this question)
- How do you think the general public perceive people with HIV?
- Why did you decide to get tested?
- Have you ever been tested before?
- Why do you think some people don't get tested?

Perceptions about the HIV testing and counselling (HTC) clinic

- How did you find out about the HTC clinic? (Probe about recommendations, accessibility, costs, location, etc.)
- Why did you chose this clinic?
- Describe your first impression of the clinic? (If the participants has already been tested in the past, how does this clinic compare to the previous one (if it was a different clinic)?)
- Describe your impression of the facilities at the clinic? (probe about rooms, waiting area)

- What do you like/ dislike about the facility?
- Describe your impression of the staff at the clinic, did you have any negative or positive experiences? (Probe about the different staff, e.g. counsellor, nurses, receptionist etc.)
    - What was the staff's attitude like?
    - We're they helpful/ informative?
    - Were there any issues around confidentiality?
    - Were they accommodating?
- What information were you given when you reported at the clinic?

Testing Issues

- What was your general experience like during testing?
    - Was it painful?
    - Did you feel nervous?
    - Did you understand what was happening at the time?
- What were some of your concerns, apprehensions during the testing period?
- How were the results of the test conveyed to you? How long did you have to wait until you got your results?
- If you did not receive your results, why not? If you could recommend a few changes during the testing procedure, what would it be?

Counselling Experiences

- Describe your counsellor to me. What is he/she like?
    - What was the staff's attitude like?
    - We're they helpful/ informative?
    - Were there any issues around confidentiality?
    - Were they accommodating?
- What types of counselling have you received thus far? (probe - about whether it is group or individual counselling? Prevention counselling? Condom education?)
- How does a counselling session usually run? Can you provide a snapshot of the general experience?
- Does your counsellor inspire confidence? How so?
- What are some of the valuable insights/ significant knowledge that you gained during your counselling sessions? Can you think of any ways to improve the counselling session?

Challenges and Benefits

- What do you feel are the advantages of going to the clinic for HTC services?
- What are the disadvantages of going to the clinic for HTC?
- How do you think HTC uptake can be improved?
- Are you able to share with your family/friends openly that you have been to a clinic for HTC services? What are some of your reservations about this (if any)?
- Would you persuade a friend to go to a clinic for HTC services, how would you entice him/her to do so?

Gaming

- What did you do to pass the time while waiting at the clinic?
- Do you enjoy playing digital games?
- What kind of games do you like to play?
- Would you feel comfortable playing a game knowing it was connected to HIV in some way?

II. Key Informant Interview – Target Group: MSM HTC Non-Service User

Please ensure the participant meets the following criteria before proceeding with the interview.

Inclusion Criteria

- Cis-gender male or transgender woman
- Admits to having sex with men
- Must be a resident of the Philippines

Demographic Information

- Age
- Sexual orientation
- Marital/relationship status
- Religion
- Education level
- Employment status and type of employment (e.g. employed full time, self-employed, un-employed etc.)

Knowledge and perception about HIV

- Can you describe what HIV is?
- Have you ever received information on what HIV is?
    - If yes, how and when did you get the information?
    - If not, what is the reason and do you know where to get information from?
- How can HIV be transmitted?
- Who do you think is at increased risk of transmission?
- Do you know any HIV positive person? If yes, do you know how he/she contracted HIV?
- What is the perception of the general public of HIV?

Perceptions about the HTC clinics

- Do you know about HTC clinics?
- Why have you not attended a clinic for HTC services?
- From what you know or have heard, what do you imagine a HTC clinic to be like?
- If you go to a HTC site, what do you expect to find there (e.g. describe people, service users, service providers)?
- Do you know anybody who has attended a clinic for HTC before? If, yes can you tell me more about this person and his/her experience?
- What do other people say about clinics for HTC services and people who go there?

Considerations regarding testing

- What do you imagine testing to be like?
- What are some of your concerns/apprehensions/anxieties about testing?
- Are you familiar with the process of testing? Have any of your friends (or people you know) been tested? If yes, what were their experiences of testing?
- What do you feel to be some of the benefits/disadvantages of getting tested?
- Do you know when you receive the results after getting tested?
- Do you know what happens after testing?

Notions about counselling

- Have you ever gone to see a health counsellor before? If yes, describe circumstances and your experiences of it.
- What do you imagine you'd learn from a counsellor (if have not seen one previously)? What do you think are some of the advantages/disadvantages of seeing a counsellor?
- What would it take for you to go see a counsellor? (Probe on life circumstances, etc.)

- Do you know of anybody who has seen a counsellor before? What were their experiences?
- Do you see yourself going to a counsellor anytime in the future, if not why not?

Factors influencing their decision to go/not go to an HTC site

- What conditions would compel you to go to an HTC site?
- What are some of your reservations/ anxieties/ concerns about going to an HTC site?
- What would make it easier for you to go to an HTC site?

Gaming

- Do you enjoy playing digital games?
- What kind of games do you like to play?
- Would you feel comfortable playing a game knowing it was connected to HIV in some way.

Appendix 2: Chapter 3 Step 1 Game Design Workshop Facilitators Guide

Facilitators Guide: Participatory Game Design Workshop

Venue: 2nd Floor, Sikat Building, Tomas Morato, Quezon City

Dates and time: 24th and 26th of November 2016 11am-3pm (lunch break at 1pm)

Lead facilitators:

1. Charlotte Hemingway - Research Assistant LSTM
2. Eufracio C. Abaya – Professor University of the Philippines Diliman

Co-facilitators:

1. Emmanuel Baja – Professor University of the Philippines Manila
2. Jody Dalmacion – Professor University of the Philippines Manila
3. Paul M. B. Medina – Professor University of the Philippines Manila

Note taker and transcriber: Ernest Genesis - Research Assistant University of the Philippines Manila

HIV Counsellors: Klinika Bernardo

Note – given advice from the game developers at EM Studios to have smartphones as the primary distribution platform for the game, questions will focus on perceptions, use and technical requirements of mobile games. However, if through the group discussions substantive barriers to mobile game use emerge then alternative platforms/ solutions to this must be explored.

Activities in chronological order:

Activity and question guidance	Target output
Instruct participants to introduce themselves stating their age, occupation and their favourite game (inform participants that they do not have to use their real name). Encourage participants to explain why this is their favourite game.	• Popular game types; • intrapersonal and social drivers of gameplay; • participant demographics.
Using the room exercise – instruct participants to create a human scatter graph indicating their desire to play mobile games from strong desire to no desire at all (x axis) and the frequency that they play mobile games from all the time to never at all (y axis) – select individuals to explain why they have placed themselves at that point on the graph. Use photos and sketches to capture participants positions and record participant feedback.	• Mobile game use; • intrapersonal and social drivers of mobile game use; • access to mobile games.
Repeating the exercise above ask the following questions: • Use the x axis to indicate your level of agreement to the statement games can increase knowledge, and the y axis to indicate your level of agreement to the statement games can change behaviour. Then ask them if they would change their position on the y axis if the statement was changed to games can change health-related	• Perceptions and understanding of games for health; • perceived limitations of games for health; • possible facilitators of knowledge acquisition and behaviour change in games.

behaviour. (provide examples of health-related behaviour) Again, select a number of individuals and ask why they have placed themselves at a particular point. Use photos and sketches to capture participants positions and record participant feedback.	
Group discussion – facilitators and barriers to mobile game use. Encourage the participants to discuss among themselves, interjecting with probing and guiding questions when required. • What games have you stopped playing and why? • What do you look for in a new game?	• Preferred design and gameplay elements; • technical enablers and barriers to mobile game use.
Introduce participants to the concept of serious games and games for health. Explain how games are being used to promote healthy lifestyles and behaviours. State the aim of this project is to develop a mobile game to increase uptake of HIV services among adolescents and young adults in the Philippines.	• Shared understanding of games for health; • shared goal for the final activity.
In teams of no more than 6, challenge participants to develop a pitch for a mobile game to increase uptake of HIV services. HIV counsellors will act as informants for each team. The teams must then present and defend their game idea to the rest of the group allowing time for discussion.	• Preferred design and gameplay elements; • perceived effective games for health mechanics.

Appendix 3: Chapter 4 Knowledge Assessment & Stigma Scale

HIV: BitB Knowledge Assessment

The purpose of the questionnaire is to assess the games ability to communicate key information relating to HIV. We therefore request that you do not use your phone while answering the questions or discuss your answers with other participants. If you need help understanding a question, please ask one of the facilitators.

1. Unique ID_____

2. Rapid HIV tests are available for free in the Philippines?
   - □ True
   - □ False
   - □ Not sure

3. How long does it take to receive your results from a rapid HIV test in the Philippines?
   - □ 1-2 hours
   - □ 2 days
   - □ 1 week
   - □ 2-3 weeks
   - □ Not sure

4. There are clinics for confidential HIV testing and counselling in the Philippines?
   - □ True
   - □ False
   - □ Not sure

5. Employers have the right to ask you, or your healthcare provider, for your HIV status?
   - □ True
   - □ False
   - □ Not sure

6. Should you get a negative HIV test result while engaging in unprotected sex, when should you test again?
   - □ The next day
   - □ In 6 weeks
   - □ In 10 months
   - □ Not sure

7. You do <u>not</u> need to get tested for HIV if…

You have sex with people that look healthy.	True	False	Not sure
You are in a committed relationship.	True	False	Not sure
You always use condoms.	True	False	Not sure
You have no symptoms or weight loss.	True	False	Not sure

8. HIV weakens the immune system, which can increase the chance of you having which of the following?

Gonorrhoea	Y	N	Not sure
Haemophilia	Y	N	Not sure
Diabetes	Y	N	Not sure
Herpes	Y	N	Not sure
Hepatitis B	Y	N	Not sure
Cystic Fibrosis	Y	N	Not sure
Tuberculosis (TB)	Y	N	Not sure
Down Syndrome	Y	N	Not sure
Cancer	Y	N	Not sure

9. Do you agree or disagree to the following statements about HIV treatment, known as antiretroviral medication (ARV)?

People with HIV on ARVs can live just as long and happy life as people who don't have HIV.	Y	N	Not sure
ARV tablets must be taken for the rest of your life.	Y	N	Not sure
ARVs can prevent mother to child transmission of HIV during pregnancy.	Y	N	Not sure
ARVs taken correctly can reduce your viral load to undetectable levels.	Y	N	Not sure
If a person with HIV has an undetectable viral load they can't pass on the virus.	Y	N	Not sure
ARVs are only prescribed when a patient is diagnosed with AIDs.	Y	N	Not sure
ARVs cannot cure HIV they can only keep it under control.	Y	N	Not sure
ARVs protect the immune system, keeping it strong and you healthy.	Y	N	Not sure
ARV causes rapid weight loss.	Y	N	Not sure
ARVs can reverse the physical effects of HIV infection, such as weight loss, within a few months.	Y	N	Not sure
All types of ARVs have severe side effects.	Y	N	Not sure

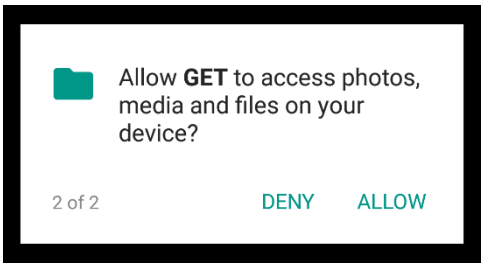
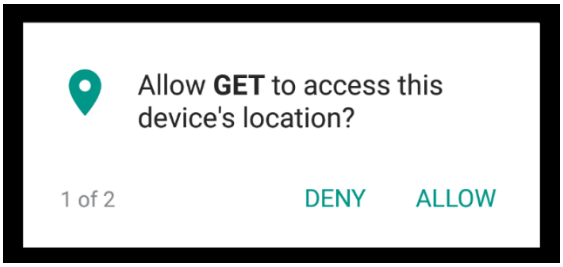
10. Mark your level of agreement to the following statements about life as someone with HIV.

	Strongly Disagree			Strongly Agree
People I care about will stop calling after learning I have HIV.	1	2	3	4
I will lose friends if I tell them I have HIV.	1	2	3	4
Some people will avoid touching me if they know I have HIV.	1	2	3	4
I must work hard to keep HIV a secret.	1	2	3	4
Telling someone I have HIV is risky.	1	2	3	4
I must be very careful who I tell that I have HIV.	1	2	3	4
Most people believe a person who has HIV is dirty.	1	2	3	4
People with HIV are treated like outcasts.	1	2	3	4
Most people are uncomfortable around someone with HIV.	1	2	3	4
I will feel guilty because I have HIV.	1	2	3	4
People's attitudes about HIV would make me feel worse about myself.	1	2	3	4
I would feel I'm not as good a person as others because I have HIV.	1	2	3	4

Appendix 4: Chapter 4 Prototype Testing Facilitators Guide

Prototype Testing Facilitator Guide

Schedule

Time	Description
15 minutes	**Introduction** Conduct a short introduction with participants using slide set provided. Introduce the project. Explain to them clearly the purpose of the testing session and how their input will feed into the game development. Describe clearly the different methods we will be using to obtain their feedback and what is expected from them, these include: • Video recordings • Screen capture • Player commentary • Questionnaire • Group discussion • Facilitator observations • Game metrics Explain that the game is a beta version and not the final product: • Most of the artwork and animations are not finalised but we still want participants to speak about the artwork and animations, what they like/ don't like and what they would change/ would like to see. • All audio in the game is placeholder and will be changed. **Do not talk about the key messages in the game or anything about the storyline as this may bias the findings.** The only description of the game is that it is a mobile game designed to promote HIV testing and counselling. **Gameplay Set Up** Check that the game is installed and running on all devices. Ensure participants are situated in view of the cameras. Cameras should be focused on the participants face. **Tip: make sure cameras have enough battery life for 2 hours of footage – recommend having spare cameras/ batteries on hand* Aim to have facilitators observe a maximum of 2 participants. When first opening the game 2 messages will appear:   Please ensure 'allow' is selected for both messages. Screen Capture: For iOS devices please use one of the solutions listed on the webpage to record the screen: https://filmora.wondershare.com/screen-recorder/best-ios-screen-recorder.html

For Android devices use AZ recorder:
https://play.google.com/store/apps/details?id=com.hecorat.screenrecorder.free&hl=en_GB

15-30 minutes **Pre-gameplay Survey**

Print the pre- and post-gameplay versions of the survey. Note the questions are the same in both versions but the order is different. Instruct participants to complete questions 1-10, advise that if they are unsure of the answer to respond 'not sure' to the question. Survey must be completed under exam conditions, i.e. no coffering with other participants or use of mobile devices. *Questionnaire is currently in English only so translation may be required.*
Unique ID should be completed by the facilitator = Location (UK/PH), todays date, stakeholder (SH) or target user (TU), Number
For example: PH08SH01 – would be used for a HIV peer counsellor

30-45 minutes **During Gameplay**

Encourage participants to regularly describe how they are feeling and what they are doing.
Do not assist the player in using the game, even if they become stuck and are unsure how to proceed. During sticking points question the players on what caused the confusion and what they believe the solution is.
There may be some instances where you will need to provide guidance, for example:

- To confirm the identification of bugs
- To provide definitions of terminology used in the game (please ensure you make a note of anytime a participant did not understand a term in the game)
- If the player has not been able to proceed for a significant period of time

Use the following questions to prompt players to verbalise their thoughts and assess their cognitive understanding of the games interface and storyline:
**when playing a level*

- What do you think the goal of this level is?
- What do you think the glowing icons do?
- Can you describe what's happening in the top half of the screen?
- Do you know why you lost that level?
- Do you know why you won that level?
- What's your strategy in this level?
- Why have you chosen that strategy?
- Can you describe what each of the icons on the board do?
- Do you know which icons are attack and defence moves? How do you know/ how did you figure it out?
- What do the stars mean to you, do you want to collect all three?
- Are there any other rewards in the game you'd like to get?
- Do you feel like the game gives you enough guidance to complete the level?
- Do you want to see more or less instructions and hints?

**when watching an animation*

- Why did you chose to skip the animation?
- In your own words, what do you think the story is?
- Can you describe the connection between the game levels and the animations? (you may need to repeat this question as previous testing has shown that players often do not see any connection until later levels)

**General*

- Have you tried accessing any other features in the game apart from the levels and animations? If so what did you open and why?

- Are you able to read the text in the game?
- How are you feeling?
- What do you think about the difficulty of the game? Too easy, too difficult? (keep asking this as they progress the assess the balancing of the levels)
- What do you think about the avatar?

Use the playability heuristics in figure 1 to guide the notes you take and questions you ask.

Reporting Bugs

A bug is something in the game that is not working as it should. These should be reported using the google sheet in the beta testing folder on Google drive asap.

30 minutes	Lunch
1 hour 30 minutes	**Focus Group Discussion** The aim of the focus group discussion is to assess comprehension, credibility and acceptability of the 9 section animations and the comprehension of overall storyline in the game and how the game levels and animations are connected. The section animations can be accessed via the google drive and should be played in sequence to help participants remember what happened in each story before providing comments. Recommend playing one animation then asking questions and allow discussion before moving on to the next. https://drive.google.com/drive/folders/0B7Z3jBTNUcJZb3hMZmlGQzVnakE?usp=sharing Playability of the game should have been explored in plenty detail during gameplay. Use the topic guide flexibly. The facilitator should encourage participants to discuss their interpretation of the animation and game storyline among themselves. Start with the icebreaker but let the participants direct the conversation and use guiding questions as and when appropriate to keep the discussion focused.
15-30 minutes	**Post-gameplay Survey** A repetition of the pre-gameplay survey using the post-gameplay version.

Focus Group Discussion Guiding Questions

Icebreaker

- Show us your avatar (avatar the player designs in the game) – tell us why you've designed your avatar this way?

Perception and understanding of game animations/ storyline

*ensure participants have seen all 9 animations

Comprehension:

- In your words, what's the story being told in the game?
- In your words, what's the message of the story?
- In your words, what is the connection between your avatar and the characters in the animation?

- Of the 9 animations were there any that stood out to you?
    - Probe: What made this stand out?
- Of the 9 animation were there any you didn't understand?
    - Probe: What did you find difficult to understand?
    - Probe: What would you change to make it easier to follow?
- What would you change in the game to improve the storyline and why?
- What would you change in the animations to improve the storyline and why?

Credibility:

- Do you think the stories presented in the 9 animations are believable? Were any of them not believable?
    - Probe: Why or why not?

Acceptability and Appropriateness:

- How did the story or messages in the game make you feel?
    - Probe: What was it about the story or message that made you feel this way?
- Is there anything you would change?
    - Probe: Why and how would you change it?
- Of the 9 animation were there any you did not like?
    - Probe: What didn't you like about it?
    - Probe: What would you change?
- What do you think about the games ending?
    - Probe: would you change it in any way?
- Do you find repeating the first half of the animation helpful?

Section animation 9:

- What answer did you select in the first half of the 9th animation?
    - Probe: Did you get the outcome you were expecting?
- What do you think would happen if you had selected a different answer?
- Do you think the question is too easy or difficult?
    - Probe: Why?
    - Probe: Would you change the question? How?

Game metrics

- The game automatically captures data on how many levels you've played, responses to the questions and a proxy measure of your location when the game was downloaded. Would the collection and use of this data discourage you from playing the game?

Figure 1: Playability Heuristics
Use the playability heuristics to guide the notes you take and questions you ask during gameplay.

Knowledge Matrix

The following table lists the learning objectives of the game, where they feature in the game and where each learning objective will be assessed during the prototype testing.

Learning Objective/ Message	Location in game	Assessed
To know treatment of HIV is available in the Philippines and to know the benefits of early access to treatment. • Saves lives • Improves health and appearance • Reduces risk of transmission	Animation storylines – ARV feature in every story. In early animations characters are depicted in positive situations and look healthy after receiving ARVs. A healthy baby is shown in the story with the pregnant character and the doctor explains ARVs will protect her unborn child. In later animations characters that are symptomatic at the time of testing drastically improve in appearance in a matter of months once they start treatment. Gameplay- ARVs are one of the board icons in the levels and a description of the icon is available in the game menu with links to online information. A clock is one of the icons on the board and represents timely access to healthcare, a description is given in the game menu. Also as the levels progress and the characters in the storyline are symptomatic the difficultly increases and the HIV virus is much stronger. In-game questions - A question on ARVs is in the game and contains links to online information.	Pre-post knowledge survey Q 9. FGD to further explore knowledge and perceptions. In-game question Q 9 + 12.
To know rapid HIV tests are available for free in the Philippines.	Animation storylines – A sign with Free Rapid Testing appears in most of the storylines. The time periods are described in the storyline.	Pre-post knowledge survey Q 2 + 3.
To know that your HIV status is confidential and that your employer can not force you or your healthcare provider to disclose your status.	Animation storyline – one character avoids testing over fear he will lose his job. He eventually tests once he becomes ill. The story ends with him looking much healthier and receiving praise from his boss for a recent report. The word confidential is used across several animations. In-game questions – a question on the employers right to force your or your healthcare worker to disclose your status is asked. The right	Pre-post knowledge survey Q 4 + 5. In-game question Q 10.

	answer is explained to the player after they answer.	
To believe you can still lead a fulfilling life after diagnosis.	Animation storyline – 8 of the animations end with the character in a positive or empowered situation. Several characters share their view that their fear nearly cost them their lives and that their fear was misplaced.	Pre-post knowledge survey 12-point stigma scale Q 10. FGD to further explore perception of characters in storyline, believability and perceptions of real world stigma.
To identify some of the common opportunistic infections associated with HIV.	Animation storyline – Gonorrhoea, Herpes zoster, Hepatitis B, TB and cancer feature in the later animations. With TB and cancer featuring in the characters that delay testing for many years. Gameplay – you also battle these microbes alongside the HIV virus in the levels.	Pre-post knowledge survey Q 8.
To know you should test twice if you have put yourself at risk.	Animation storyline – depicts a character that tests the same day he engaged in unprotected sex, he is advised to test again in 6 weeks but comes back 10 months later and discovers he is positive.	Pre-post knowledge survey Q 6. In-game question Q 6.
To identify misconceptions about risk: • A healthy person can be infected. • You may still be at risk even if you are in a committed relationship. • Heterosexual couples are also at risk.	Animation storyline – 1 storyline shows a heterosexual couple, others the sexuality is not expressly stated, 1 shows a married couple where the wife is in denial of the result because she trusts her husband, the characters in the early animations look healthy.	Pre-post knowledge survey Q 7. FGD to explore cognitive understanding of storylines.
To know condoms can prevent transmission.	Gameplay – condoms are one of the board icons and increase player defence and the bonus reduces the enemy attack. A description of the icon with links to online information is available in the game menu.	Pre-post knowledge survey Q 7.

Appendix 5: Chapter 4 Example Playability Report

Philippines Beta Testing 20/08/2017 Playability Report

Participant Demographics

Participant	Age	Gender	Profession	Device used
PH20TU01	20	M	Student	iPad
PH20TU02	20	M	Student	iPad
PH20TU03	20	M	Student	iPad
PH20TU04	27	M	Content Associate	iPad
PH20TU05	24	M	Student	iPad

Facilitators: Emmanuel Baja, Paul Medina Smart, Ernest Genesis, Jody D.

***Identifiers used in transcript have been changed so that participant quotes are identified using their beta testing UID**

PH20TU01 Respondent A
PH20TU02 Respondent B
PH20TU03 Respondent C
PH20TU04 Respondent D
PH20TU05 Respondent E

Playability Testing

Participants were recruited through a DOTA network so were all serious gamers. They believed the game would mainly appeal to casual gamers, however, as the game could be played offline there was a chance that serious gamers would pick the game up and complete it in under a week while sat in traffic. They warned that the game would require effective advertising to ensure it got picked up in the app store.

In general, participants were very positive about the game. They really appreciated the quality of the art work and animations and found it an enjoyable experience.

They found the gameplay easy to understand and could proceed through the levels. They felt that they had to think about their strategy by level 15, whereas earlier levels could be completed with very little thought involved. Most playability issues centred around the desire for additional onboarding when new game mechanics appeared and for the design of the icons to support the gameplay to make their effect more intuitive to the player.

Game Usability

GP5 There are no repetitive or boring tasks

Reported violations: 2

1/ Participants felt bored from the repetition of the intro animation which plays twice within a chapter. The intro animation can be skipped on the second play through but this did not appear to be apparent to the participants with no one observed skipping the animation by tapping anywhere on the screen.

> *I've only had difficulties with the animations so far. Like it shows you a part of the whole animation on the first part, then when you finished the round, when you've defeated the enemy, the animation still starts from the beginning. It made me feel*

bored. It would be more game friendly is half of the animation is shown on the first part, then after the gaming part, it would continue where the story left off. I think it would be better that way. - PH20TU02

The game consists of parts where you play the game at one part and at a certain level it will show again what had happened in the first scene, and then there's some sort of ending at the last part. So, what you wanted was to just continue where it left off and not show anymore the first part? - ESB

Yes, so that you'll also not lose the momentum of playing the game. - PH20TU03

Resolution:

Before removing the automatic replay of the second animation this should be explored further through additional testing to see if it is detrimental to the pace and enjoyment of the game.

An addition of a skip icon during second play through or only showing the last scene of the intro animation before the outro are two possible solutions that should be considered.

2/ While players did not experience the last batch of levels and animations when they were told that they would have to repeat the 10 levels to see the alternative endings they believed this would be frustrating for players.

This loop is from level 81-90... - ESB

So, it will repeat everything from there? – PH20TU01

Yes. - ESB

I kinda feel like it's frustrating if you will have to go through it for that many levels. – PH20TU01

Can't the player just repeat level 90? [laughs] – PH20TU05

Okay, we'll suggest that. - ESB

Yes, because it's the final round already. You might bore the player if you'd loop him or her to a level far beyond what he or she actually reached. Instead of playing aggressively, you might make the player uninstall the game because of frustrations. – PH20TU04

Resolution:

Consider having players only repeat 1 level. Look at making the last level different from all other levels so it is seen as a final boss battle.

GU1 Audio-visual representations support the game

Reported violations: 1

**also reported in UK beta testing*

Players reported the icons as unintuitive in terms of figuring out their effect from the design. The colour of the icons did not correspond with the status bars they effected.

Ah sir, first of all, the gameplay is easy to understand because it's a casual matchgame. But the main problem is the mechanics itself, which we are saying, like if you match green icons, we thought it would increase the health but it went to attack. And then the pills went to attack, too—even though the color of the pills is blue and that the attack is colored red. And it's not that intuitive that the red signifies attack because of the lightning symbol which, in similar games, it corresponds to energy or something. We can change it to a sword or something. - PH20TU05

The most confusing icon was the healthcare icon which is a shield shape but effects the attack.

What do you think that icon signifies? - ESB

Shield. Like plus health. - PH20TU01

What is it really? - PH20TU05

Health. Like if you're healthy... - ESB

Ah, so it somehow represents your immune system. Since it's a shield, all along we thought it's for defense. - PH20TU05

Resolution:

Discuss and adapt the design of the board icons using colours and shapes that link up with the status bars.

GU11 The game contains help

Reported violations: 1

**also reported in UK beta testing*

Participants did not feel the onboarding was comprehensive enough and new mechanics in the game were not explained when they first appeared. They also stated that written instructions should be avoided as they most likely wouldn't read the text.

So, if there's something new aside from the icons, you wanted to have instructions? - ESB

Yes. Even if it's just on the beginning level. Even if it's a one-time instruction. - PH20TU05

Or it can be a quick animation detailing what the following icons are for and what will happen if you do this and that... Because, it's word text is unappealing, maybe an animation that shows that if you do this, this would happen. Something like that. - PH20TU04

Won't you get bored with that? - ESB

No, because you have the option to tap it if you won't to play immediately. At least, you were given instructions beforehand. - PH20TU04

It will be quicker actually if you animate it. - - PH20TU05

Because in the game, it seems like it was just shown then without further instructions, you play the game without knowing what to do with those icons. - PH20TU04

And I'm actually lazy to read stuff so I'd rather prefer it to be animated - PH20TU01

Resolution:

When a new mechanic appears for the first time in the game the level could run a very short tutorial, exactly as it does in level 1, which demonstrates how to interact with the new game unit. Before finalising a spec for the onboarding this should be explored further through additional testing. Adjusting the design of the icons and balancing the levels is likely to affect the requirements for onboarding.

Gameplay

GP6 Players can express themselves

1 participant expressed a desire to be able to customise the mech-suit as this was what they saw most of in the game.

Because right after entering the robot suit, the customization becomes useless because you can only see the face and not the full customized character that you designed. You can just see your character in when you enter the level select part. You can actually put any avatar there, and it wouldn't matter. I just hope that when you can customize the avatar, you can also customize the robot because it is the one that you see most often. - PH20TU05

Resolution:

Add mech-suit options to the avatar customisation screen provided this doesn't affect the development time and incur additional costs.

Or show the avatar out of the mech-suit more frequently in the game.

GP2 Player is rewarded and rewards are meaningful

Reported violations

* *also reported in UK beta testing*

Participants responded negatively towards the ancient fragment reward. They didn't see how it fitted with the game's storyline.

And then, there's also this impression that when you finish the level, the congratulations part, or the 'stage cleared' part, it looks like you're inside the vagina. [laughs] - PH20TU05

And I actually don't understand the meaning of the fragment... - PH20TU04

Other respondents: Yes, the ancient fragments...

I'm inside the body, right? So, how did I end up having an ancient fragment? - PH20TU04

It should be noted that at this point the players had not seen all of the animations. After watching the last animation there still seemed to be some confusion over the ancient fragments.

The idea of that one is that he's going to face off everyone. But it didn't explain that... There's no actual goal. We assumed that he needs to defeat everyone. And then the fragment came out of nowhere. – PH20TU04

I was surprised that after finishing one section, the ancient fragment showed up. – PH20TU05

And it wasn't explained what it is for. – PH20TU01

And it seems like there's no relation to the animation. Not unless you get to the end part, that's where you'd get the purpose of that thing. – PH20TU04

It sparks your curiousity as to where you would need to use that fragment, why it exists... – PH20TU03

Participants noted that it would be helpful to show that the ancient fragments were part of a collection that came together to make something.

Or to make it more exciting, you can actually foreshadow it with the whole piece. Like you'll show that it's a part of something bigger. And as you progress through the levels, you'll show that you're beginning to unfold what the piece really looks like. – PH20TU04

Resolution:

Re-design the 'Chapter complete, ancient fragment discovered screen' to show the total number of fragments collected at that point, thus avoiding additional menu items that players are less likely to access. As the player proceeds through the chapters they would witness the anting anting building piece by piece instead of seeing an individual piece. Consider adjusting the design of the anting anting that is more in fitting with the sci-fi theme. Maybe avoid the term ancient and instead state strange or magical fragment.

GP1 The game provides clear goals

Reported violations:

**also reported in UK beta testing*

Participants stated that it took a while to discover that most missions included 2 goals and one was optional. They expressed a desire for the optional goal to be explicitly stated as such.

Yes, in the early levels, you could easily kill it. So, for me, that's okay. But it should be clarified that the extra moves/bonuses that you need to get is optional. - PH20TU04

What should be optional? - ESB

The mission... - PH20TU04

...for the extra moves. Because... - PH20TU01

It's not actually clarified that those are optional. - PH20TU03

So, you're saying that the extra moves are not quite clear whether it's necessary to have in the game or it's just an option? - ESB

Yes, because it's just stated in the objective but not explained if it's a pre-requisite to get into the next level. - PH20TU01

Resolution:

Adjust the wording on the mission start screen i.e. Defeat the monster. *Optional: Collect all blocks for extra moves.*

Animatics

Sc01

- 1 participant reported that they weren't sure if it was the boy or the girl that was HIV positive.
- Most participants felt it wasn't believable that the boy would stay with the girl after finding out she was HIV positive.
- Participants were surprised to hear that someone on effective treatment for HIV can't pass on the virus. This is a key message in this animatic, feedback suggests it was not effectively communicated.

You can actually still test negative even though you have a positive partner, as long as she's taking the prescribed medications and her level of viral load is low—her viral load is undetectable. - ESB

So, the main idea of the ending of this animation is that the girl was treated? – PH20TU04

No. But she's taking medications and her viral load is undetectable. - ESB

That's actually the part that is not clear. Because the animation shows that there's some sort of test so I assume that the guy is involved. And it didn't show that the girl is taking meds. It went straight in showing that they had a child. It showed a happy ending immediately. – PH20TU04

Sc02

- 2 participants didn't realise the second character in bed was a man, however, participants also stated that it didn't affect the storyline whether you perceived the character as a male or female.
- 1 participant stated he would like to see the character doing other healthy things as well as the gym scene.

- Some confusion over the times stated in the animatic – may be resolved through localising game.

Sc03

- Participants felt having the character looking happy in the bar as the end scene gave the wrong message. 1 participant advised that we should show him taking his meds to create a stronger connection between treatment and lifestyle choices.

> *He was in the club, and he was feeling something different. And then the next day after, he went to a clinic, he underwent testing and then the doctor told him to go back after 2 weeks. Going back, he was told that he has Gonorrhoea and he was then given pills to cure it and the HIV treatment. With that, he told himself that this could save his life and then could continue living his life normally. And then he was seen to be at the bar again. But it was somehow an off for me because it gave me the impression that just because there's treatment, you can go on with your promiscuous activity all your life. – PH20TU01*

> *Maybe in the revision, what they can add is to show that the guy took the medications before he was shown that he's back in the club. So, people can have this impression that he's taking the medicine reason why he could go back to his former lifestyle. Without that, it gave me the impression that he doesn't care, that he became more reckless. – PH20TU04*

Sc04

- It wasn't clear why the discovery of a rash would lead to the character going to a HIV clinic and not a dermatologist.

Sc06

- Not clear when the female character became infected.

Sc08

- Participants felt the character was missing a back story. How did he become infected, why didn't he get tested?
- Some participants felt this could be stigmatising to people who have tattoos.

> *The tattoo became significant because before, there's nothing radical in the physical attributes of the main characters. And then, here we are, presented with a man with tattoo in his arms, and he didn't undergo testing, and he died. – PH20TU04*

> *The other characters don't stand out the way this character does. This one has a different flow in the story too. Like before it was related to their jobs, then computer gaming, then this scenario, out of nowhere, a tattooed guy is presented to have HIV without stating what his background is. There's no other story associated with him other than the tattoo. So, the tattoo man died, something like that. – PH20TU05*

Appendix 6: Chapter 4 Marketing Events

Description	Link
Dr Emmanuel Baja, project PI was interviewed on CNN Philippines morning news show to promote the launch of the mobile gaming app BitB. A short demo of the game was given. Follow link to online copy of the interview.	Click here
Dr Emmanuel Baja, Dr Jody Dalmacion (UP Manila) and Charlotte Hemingway (LSTM) were featured guests on a popular breakfast talk show in the Philippines, Good Morning Kuya. During the show researchers discussed the purpose of the project and how BitB was developed. A demo of the game was given. Follow link for video of the full show – skip to 1:37:00 for the interview.	Click here
Dr Emmanuel Baja, Dr Jody Dalmacion (UP Manila) and Charlotte Hemingway (LSTM) were guests on an online feature by News5 for World AIDS Day 2017. During the show researchers discussed the purpose of the project and how BitB was developed. A demo of the game was given. The show was broadcast via their Facebook channel and received over 13K views.	Click here
Dr Emmanuel Baja represented the project during The Bottom Line panel show discussion on the rapidly emerging HIV epidemic in the Philippines and the activities taking place to increase uptake of testing and access to treatment.	Click here
Dr Emmanuel Baja (UP manila) presented the project and BitB at the 18th City Council of Davao to Vice Mayor Paolo Duterte and members of the Sangguniang Panglunsod ng Davao. The full Philippines project team and Charlotte Hemingway (LSTM) were also in attendance. Dr Emmanuel Baja, Dr Jody Dalmacion and Charlotte Hemingway also attended a local government media event to promote the launch of the game at the World AIDS Day event in Davao.	Click here
A 4-day competition was held during the national World AIDS Day event in Davao. 60 competitors from 3 districts played BitB with the finals held on the last day of the event. Audience members also competed for prizes by downloading and playing the game. The competition was held to celebrate the global launch of BitB on the Google Play and App Store. Over 500 individuals downloaded and played the game during the competition, 92% from the Philippines.	Click here
The HIV GET Facebook page regularly posts information on HIV testing and treatment services and promotional material for the game. The page is also used to support recruitment for research activities by posting adverts. The page is maintained by research assistants in the Philippines. LSTM staff have administrative access to the page and contribute to the content. As of the 1st of February 2018, the page has 1,037 followers. Posts on the page reached over 82,000 Facebook users in January 2018. Users send any queries or concerns they have regarding HIV testing and treatment services or the game through posts or the private messaging service. Research assistants maintain a 100% response rate to messages.	facebook.com/HIVGET/
Throughout the 12-month pilot, UP and LSTM researchers have run a series of promotional exhibition booths for the game, visitors were awarded a prize for downloading the game or reaching a certain level, had the opportunity to speak with researchers about the project and	

were offered advice on HIV services in the Philippines, free condoms and lube. Events included but were not limited to the: eSports and Gaming Summit, Manila 2018; HIV/AIDS Colloquium by SOAS University of London, Manila 2018; 14th National Biotechnology Week, Pasay City 2018; 17th National Health Research Forum for Action, Manila 2018; PNHRS 12th National Conference, Baguio City 2018; BPO Beauty Queen Pageant, Manila 2018; White Beach Holy Week Festival, Puerto Galera 2018; Gamecon.ph Manila 2018; Health Symposium and Game Challenge University of the Philippines, Manila campus 2018.	

Appendix 7: Chapter 5 Interview Topic Guide

Numbered questioned in bold should be asked as they are written. Bullet points under each question are there to help you in choosing when and what to probe for.

Questions do not have to be asked in the order they appear in this document. The aim is for the activity to feel more like a conversation than an interview.

Thank you for taking the time to talk to me today and for consenting to talk part in the study. I'd like to talk to you today about your experience playing BitB as well as your knowledge and feelings towards HIV and HIV services in the Philippines.

(reiterate their rights before confirming they are happy to commence the interview)

Topic: Extrinsic/ intrinsic motivators for game use.

1. **How often do you play games on your mobile?**
2. **What type of mobile games do you play?**
    - If they stated that they rarely or never play mobile games, have they explained why.
    - If they mention a particular type of game, have they explained what it is about this type of game they find most appealing/ engaging.
    - Have they talked about any benefits they gain from mobile games and particular game types?
    - Have they spoken about mobile games they do and don't like?

3. **Can you tell me about how you first discovered BitB and why you chose to download it?**
    - If they mentioned a marketing/ promotional event, what incentives to download the game were offered at the event and did this effect their choice.
    - If they mention the games educational nature or content as a motivator, have they explained why this is appealing to them.
    - If they state they were curious about the game, have they explained which feature/ part of the game they were curious about.
    - If they state that someone encouraged them to download the game, have they explained how the game was described to them and the effect it had on their choice.

Topic: Perceptions of gameplay and narratives.

1. **How would you describe BitB to someone else?**
    - When describing the game what feature did they focus on and did they explain why they focused on this feature.
    - Would they recommend the game to someone else, who would they recommend it to and why?
    - If their description is predominantly negative do they hold any positive perspectives of the game and what are they? (+ vice versa)
    - Have they described the narratives and characters in the game at all?
    - If they spoke about a particular animation, can they remember what they story was about.
    - Have they expressed any beliefs on the narratives purpose?
    - If they mention any positive or negative perceptions of the narrative(s), have they explained why they hold this perception.
    - Did they find the characters/ storyline they witnessed believable or relatable in any way?
    - Did they mention any health messages within the narratives, and if so did this represent new information?

2. **You reported that:**

a) you are currently on level xx and still have the game installed, do you plan to continue playing the game?

b) You reached level xx and have uninstalled the game, why did you choose to stop playing the game?

- Have they explained why they would either keep playing or have stopped playing.
- Is there anything they would change about the game, have the explained why they would make this change?

3. **What do you think the purpose of the game is?**
   - If they state the games purpose is to change knowledge and/or attitudes, can they provide examples of specific knowledge and/or attitudes they believe the game can/ has changed.
   - If they state the games purpose is to change behaviour, can they explain the specific behaviour it will change and how they believe the game will achieve this.
   - If they state the games purpose is to gather data, have they explained why they believe this and how they believe the data will be used.

Topic: Perceptions of in game questions and game use data

4. **Do you remember answering any questions in the game?**
   - Did they mention the demographic questions; if not, probe on whether they remember responding to the questions on age, gender, gender of sexual partners and sexuality.
   - Have they expressed their feelings towards of the in-game questions?
   - Have they described what they believe the questions are used for?
   - Have they expressed any concerns over the in-game questions, have these concerns effected their responses in any way?

5. **Are you aware that BitB collects information from your device when you play the game, but only if you give permission to access the information?**
   - Did they give any correct/ incorrect examples of data that is collected from the device?
   - Have they expressed their feelings towards using the game to collect information from their device?
   - If they were not aware how could this have been made clearer?

Topic: Impact of game on knowledge & attitudes towards HIV and HIV services

I'd like to now focus on your knowledge and feelings towards HIV and HIV services here in the Philippines.

6. **Can you describe what it would be like to get tested for HIV in the Philippines?**
   - Have they expressed feelings towards the clinics/ clinic staff?
   - If they expressed any negative/ positive perceptions towards HIV services, what effect has this had on their behavioural intention?
   - How confident do they feel in their own ability to undergo a HIV test and why?
   - Do they believe the characters experience of getting tested in the game reflect their perspectives?
   - Have their perceptions of HIV services changed and what caused that change?
   - What type of HIV testing service did they describe, and have they explained why they described this particular type?

- Ask: If you were to get tested for HIV tomorrow can you take me through how you would do this?
- Have they expressed how long a HIV test will take?
- Do they have any perceptions on the confidentiality of the test?

7. **Can you describe what life would be like as someone living with HIV in the Philippines?**
   - Impact on important relationships?
   - Impact on career/ job prospects/ education?
   - Impact on health & wellbeing?
   - How would their life be different compared to someone who does not have HIV?
   - Do they believe the characters/ stories in the game reflect their perspectives?
   - Have they explained why they hold these perspectives?
   - Have their perspectives changed and what caused this change?
   - Have they talked about treatment and its effects?
   - Ask: What options do you believe a person has to reduce the impact HIV has on their lives?

8. **How important to you is knowing your HIV status?**
   - Have they explained why they hold this perception?
   - Has their perception changed and what caused this change?

9. **Who do you think should get tested for HIV and why?**
   - Did they talk about themselves?
   - People in committed relationships?
   - Specific behaviours that put people at risk?
   - Gender?
   - Sexual identity?
   - People with/ without symptoms?
   - Has their perception changed and what caused this change?

Topic: Enablers to barriers to act upon behavioural intentions

10. **Have you talked to anyone about HIV?**
    - What did they talk about?
    - Who did they talk to and why them?
    - Did the conversation have any impact on them or the other person(s)?
    - How comfortable do they feel about talking about HIV? Does this change depending on who they talk to?
    - Did BitB play any role in them talking about HIV to this person(s)?
    - Ask: Has there been any change in the way you talk about HIV?

11. **Have you done any research on HIV?**
    - What specifically did they look into?
    - Why did they conduct this research?
    - What did they gain from their research?

12. **Have you ever been tested for HIV?**
    - If they have are they willing to talk about when they were tested and what led them to get tested.

- If they haven’t are they willing to talk about why they have not undergone a HIV test.
- If they haven’t, would you consider getting tested for HIV in the near future.
- Any mention of health system, social system or economic barriers?

Topic: Participant demographics

13. **What gender do you identify with?**
14. **How would you describe your sexual identity?**
15. **What is your highest educational attainment?**
16. **Are you currently employed?**

Appendix 8: Chapter 5 Clinic Survey

Please read the information below before completing the 8 questions.

The following is a short survey to assess awareness of a promotional mobile game for HIV testing and counselling services in the Philippines. The game is titled BitB and is available for free on the Google Play and Apple App stores.

This study is being conducted in collaboration with the Department of Health, Institute of Clinical Epidemiology, UP Manila National Institutes of Health, and the Liverpool School of Tropical Medicine.

You have been invited to take part in this research because you have chosen to attend HIV testing and counselling services in the Philippines. It is your choice whether to participate or not. If you choose to participate, you may change your mind and leave the study at any time. Refusal to participate or stopping your participation will involve no penalty or loss of benefits to which you are otherwise entitled.

The data collected from this survey will not contain any identifiable information such as your name, residential address or job title. The information/data collected will have no identifying information that could be linked to you instead a unique random ID number will be assigned for your anonymity. All data obtained will be treated as confidential and paper-based forms will be stored under lock and key. Encoded data will be password-protected. In addition, no identifying information will be used in any written report resulting from this research. Data collected, may be seen by the Institutional Review Board (IRB) that oversees the research. We may also share your information related to this study with other parties including translators, transcribers, research associates, co-investigators and/or the management of DOH as applicable.

The Principal Investigator of this study is **Dr. Emmanuel S. Baja, ScD**. He can be reached Mondays to Fridays 9am – 5pm at cellphone number +63917-626-6492 or via email esbaja@gmail.com

- If you have questions, concerns, or complaints,
- If you would like to talk to the research team,
- If you think the research has hurt you, or
- If you wish to withdraw from the study.

Maaring pakibasa muna ang mga nakalakip na impormasyon bago sagutin ang walong katanungan.

Ang sumusunod ay isang maikling survey upang tukuyin ang kamalayan ng mga gumagamit pagdating sa mobile game para HIV testing at counselling services sa Pilipinas. Ang laro ay pinamagatang BitB at ito ay magiging available ng libre sa Google Play Store at Apple App Store.

Ang isinasagawang pag-aaral ay katuwang ang Department of Health, Institute of Clinical Epidemiology, UP Manila National Institutes of Health at Liverpool School of Tropical Medicine.

Ikaw ay iniimbitahang makilahok sa pag-aaral na ito dahil ninais mong dumalo sa HIV testing and counseling services sa Pilipinas. Nasa sa iyo kung nais mong tumuloy o hindi makilahok. Kung nanaisin mong lumahok, binibigyan ka pa rin ng pagkakataong lumisan sa pag-aaral sa kahit anong oras mo naisin. Ang iyong pagtanggi sa paglahok ay walang kalakip na parusa o pagkawala ng benepisyo.

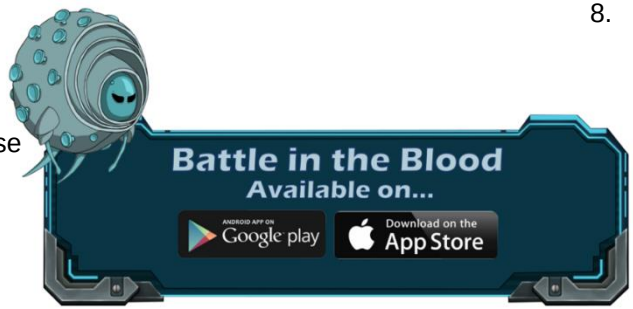
Ang mga impormasyon na makokolekta sa survey na ito ay hindi maglalaman ng anumang datos na maaring tumukoy sa iyo tulad ng iyong pangalan, tirahan, o trabaho. Ang lahat ng datos na nakuha ay ituturing bilang kumpidensyal at ang mga papel ay maiimbak sa ilalim ng lock at key. Ang mga naka-encode na datos ay protektado ng password. Walang pagkilala sa impormasyon ang gagamitin sa anumang nakasulat na ulat na nagreresulta mula sa pananaliksik. Ang datos na nakolekta ay maaaring makita ng mga institutional review board (IRB) na nangangasiwa ng pananaliksik. Maaari rin naming ibahagi ang iyong impormasyon na may kaugnayan sa pag-aaral na ito sa iba pang mga partido kabilang ang mga tagasalin, transcribers, research associates, mga co-investigators at / o ang pamamahala ng DOH.

Ang Punong Mananaliksik sa pag-aaral na ito ay si Dr. Emmanuel S. Baja, ScD. Makakausap siya mula Lunes hanggang Biyernes, ala-9:00 ng umaga hanggang alas-5:00 ng hapon sa cellphone number +63917-626-6492 o sa pamamagitan ng email esbaja@gmail.com

- Kung mayroon kang mga katanungan, mga alalahanin, o mga reklamo,
- Kung nais mong makipag-usap sa koponan ng pananaliksik,
- Kung sa tingin mo ang pananaliksik ay nasaktan ka, o
- Kung nais mong umalis na mula sa pag-aaral na ito.

1. Today's date_____
2. Are you aware of the mobile game BitB?
   - ☐ Yes
   - ☐ No **(*If you answered no please skip to question 6)***
3. How did you hear about the game?
   - ☐ App store (Google play, Apple)
   - ☐ Poster/ Billboard
   - ☐ Social Media (i.e. Facebook, Twitter)
   - ☐ Dating app (i.e. Grindr, Growlr, Project Romeo)
   - ☐ Print/ Radio/ TV
   - ☐ Friend
   - ☐ Other; please specify_____
4. Have you played BitB?
   - ☐ Yes
   - ☐ No
5. Has the game played any role in your decision to attend the clinic today?
   - ☐ Yes
   - ☐ No
6. How old are you?
   - ☐ less than 10
   - ☐ 10-14
   - ☐ 15-19
   - ☐ 20-24
   - ☐ 25-34
   - ☐ 35-49
   - ☐ 50 and above
   - ☐ Do not want to disclose
7. You are?
   - ☐ Male
   - ☐ Transgender (male to female)
   - ☐ Female
   - ☐ Transgender (female to male)
   - ☐ Other; please specify _____
   - ☐ Do not want to disclose
8. Who have you had sex with?
   - ☐ Male only
   - ☐ Female only
   - ☐ Males and females
   - ☐ Do not want to disclose

1. Petsa ngayon: _____
2. May kaalaman ka ba sa mobile game na BitB
   - ☐ Meron
   - ☐ Wala **(*Kung ang iyong sagot ay wala, lumaktaw sa Question 6)***
3. Paano mo nalaman ang tungkol sa laro?
   - ☐ App store (Google play, Apple)
   - ☐ Poster/Billboard
   - ☐ Social Media (i.e. Facebook, Twitter)
   - ☐ Dating app (i.e. Grindr, Growlr, Project Romeo)
   - ☐ Print/Radyo/Telebisyon
   - ☐ Kaibigan
   - ☐ Iba pa; maaring pakitukoy _____
4. Nalaro mo na ba ang BitB?
   - ☐ Oo
   - ☐ Hindi
5. May kinalaman ba ang laro sa iyong desisyong dumalo/pumunta sa klinika ngayong araw?
   - ☐ Meron
   - ☐ Wala
6. Ilang taon ka na?
   - ☐ 10 pababa
   - ☐ 10-14
   - ☐ 15-19
   - ☐ 20-24
   - ☐ 25-34
   - ☐ 35-49
   - ☐ 50 pataas
   - ☐ Ayaw ipaalam
7. Ikaw ay?
   - ☐ Lalaki
   - ☐ Transgender (lalaki na naging babae)
   - ☐ Babae
   - ☐ Transgender (babae na naging lalaki)
   - ☐ Iba pa; maaring pakitukoy _____
   - ☐ Ayaw ipaalam
8. Ikaw ay nakikipagtalik sa?
   - ☐ Lalaki lamang
   - ☐ Babae lamang
   - ☐ Lalaki at babae
   - ☐ Ayaw ipaalam



Appendix 9: JMIR Serious Games Publication

Original Paper

Development of a Mobile Game to Influence Behavior Determinants of HIV Service Uptake Among Key Populations in the Philippines: User-Centered Design Process

Charlotte Hemingway[1], BA; Emmanuel S Baja[2], SCD, BS, MSc; Godafreda V Dalmacion[2], BSc, MSc, MD; Paul Mark B Medina[2], BS, MSc, PhD; Ernest Genesis Guevara[2], BS; Tyrone Reden Sy[2], MPH, MA; Russell Dacombe[1], MSc; Claire Dormann[3], MSc, PhD; Miriam Taegtmeyer[1,4], BM, MA, ChB, FRCP, PhD

[1]Department of International Public Health, Liverpool School of Tropical Medicine, Liverpool, United Kingdom

[2]Institute of Clinical Epidemiology, National Institutes of Health, University of the Philippines, Manila, Philippines

[3]Department of Vector Biology, Liverpool School of Tropical Medicine, Liverpool, United Kingdom

[4]Tropical Infectious Diseases Unit, Royal Liverpool University Hospital, Liverpool, United Kingdom

Corresponding Author:
Charlotte Hemingway, BA
Department of International Public Health
Liverpool School of Tropical Medicine
Pembroke Place
Liverpool, L35QA
United Kingdom
Phone: 44 7942118311
Email: charlotte.hemingway@lstmed.ac.uk

Abstract

Background: Opportunities in digital distribution place mobile games as a promising platform for games for health. However, designing a game that can compete in the saturated mobile games market and deliver persuasive health messages can feel like an insurmountable challenge. Although user-centered design is widely advocated, factors such as the user's subject domain expertise, budget constraints, and poor data collection methods can restrict the benefits of user involvement.

Objective: This study aimed to develop a playable and acceptable game for health, targeted at young key populations in the Philippines.

Methods: Authors identified a range of user-centered design methods to be used in tandem from published literature. The resulting design process involved a phased approach, with 40 primary and secondary users engaged during the initial ideation and prototype testing stages. Selected methods included participatory design workshops, playtests, playability heuristics, and focus group discussions. Subject domain experts were allocated roles in the development team. Data were analyzed using a framework approach. Conceptual frameworks in health intervention acceptability and game design guided the analysis. In-game events were captured through the Unity Analytics service to monitor uptake and game use over a 12-month period.

Results: Early user involvement revealed a strong desire for online multiplayer gameplay, yet most reported that access to this type of game was restricted because of technical and economic constraints. A role-playing game (RPG) with combat elements was identified as a very appealing gameplay style. Findings guided us to a game that could be played offline and that blended RPG elements, such as narrative and turn-based combat, with match-3 puzzles. Although the game received a positive response during playtests, gameplay was at times perceived as repetitive and predicted to only appeal to casual gamers. Knowledge transfer was predominantly achieved through interpretation of the game's narrative, highlighting this as an important design element. Uptake of the game was positive; between December 1, 2017, and December 1, 2018, 3325 unique device installs were reported globally. Game metrics provided evidence of adoption by young key populations in the Philippines. Game uptake and use were substantially higher in regions where direct engagement with target users took place.

Conclusions: User-centered design activities supported the identification of important contextual requirements. Multiple data collection methods enabled triangulation of findings to mediate the inherent biases of the different techniques. Game acceptance is dependent on the ability of the development team to implement design solutions that address the needs and desires of target users. If target users are expected to develop design solutions, they must have adequate expertise and a significant role within

the development team. Facilitating meaningful partnerships between health professionals, the games industry, and end users will support the games for health industry as it matures.

(JMIR Serious Games 2019;7(4):e13695) doi: 10.2196/13695

KEYWORDS

HIV; video games; health communication; persuasive communication; games; experimental; user-centered design

Introduction

The Philippines' HIV Epidemic

The Philippines has the fastest growing HIV epidemic in the Southeast Asia region. The dominant mode of transmission reported in the Philippines is sexual contact among males who have sex with males (MSM) and transgender women (TGW). As of 2017, the Joint United Nations Programme on HIV and AIDS reported the HIV prevalence rate at 0.1% for general adult population (aged 15-49 years), 0.3% among young men (aged 10-24 years), 4.9% among MSM, and 1.7% among TGW [1]. Specific data for TGW are limited [2]; however, a cross-sectional study in Cebu City in 2015 showed an 11.8% HIV prevalence rate in this group [3]. Cases are forecast to triple in the next 10 years, with the majority of new infections among young MSM (aged 15-24 years) [4]. Since the first reported case in 1984, the National HIV/AIDS and Antiretroviral Therapy Registry of the Philippines has confirmed 59,135 cases as of September 2018, of which 28% were aged between 15 and 24 years and 51% were aged between 25 and 34 years at the time of diagnosis. The proportion of HIV-positive cases in the 15- to 24-years age group has almost tripled in the last 10 years [5].

Young key populations worldwide pose a complex public health challenge; transmission rates are high, diagnosis is often delayed, and linkage to care and treatment is poor among those found to be infected [6]. Barriers to HIV services vary across contexts. In the Philippines, intrapersonal and social barriers exist alongside health system and economic barriers. Recurring themes associated with barriers to HIV services in the literature include low perceived risk of HIV infection; fear of losing access or status in important social spheres as a repercussion of accessing HIV services; lack of awareness or negative perceptions of treatment; belief that clinics do not provide confidential or private services; and restricted access to testing services because of time constraints, economic constraints, and legal constraints for those aged under 18 years [7-11].

Why Play Mobile Games?

As the HIV epidemic worsens, social changes are occurring for young people in the Philippines. Increased online connectivity, a growing economy, and prevalent mobile device use has changed the way people spend their time and socialize. This change has generated new possibilities for the public health sector to deliver targeted health messages [12]. Utilizing technology already popular among adolescents and young adults may provide access to individuals who do not otherwise engage with traditional forms of HIV education and advocacy [13]. Mobile games, in particular, offer a promising platform to address the knowledge gaps, perceptions, social pressure, and self-stigma that deter young key populations from accessing health services [14]. A recent meta-analysis of 54 digital games for healthy lifestyle promotion found small but significant effects on behavior, determinants, and clinical outcomes, demonstrating the potential benefits [15].

Mobile games contain structural elements that effectively engage users [16], and it is through these elements that mobile games could influence behavior determinants. Players can model health-related behavior and witness positive and negative outcomes within a safe environment. Well-designed narratives, integrated with the gameplay, can foster identification with the characters, thereby increasing a player's sense of personal risk or self-efficacy in overcoming barriers to HIV services [17]. Positive portrayals of characters living with HIV may help form beliefs that players can also remain or become their desired self after a positive diagnosis. Influence may also be found from the complex interplay between digital gaming and social behavior [18]. Even a single-player mobile game can trigger meaningful social interactions, from recommending a new game to offering advice on how to complete a challenge. For example, a player may recommend the game to a peer or family member who they believe could benefit from the health-related content. Narratives and characters within the game could also trigger meaningful conversations within social groups. Such use of the game could generate social pressure about health-related behavior.

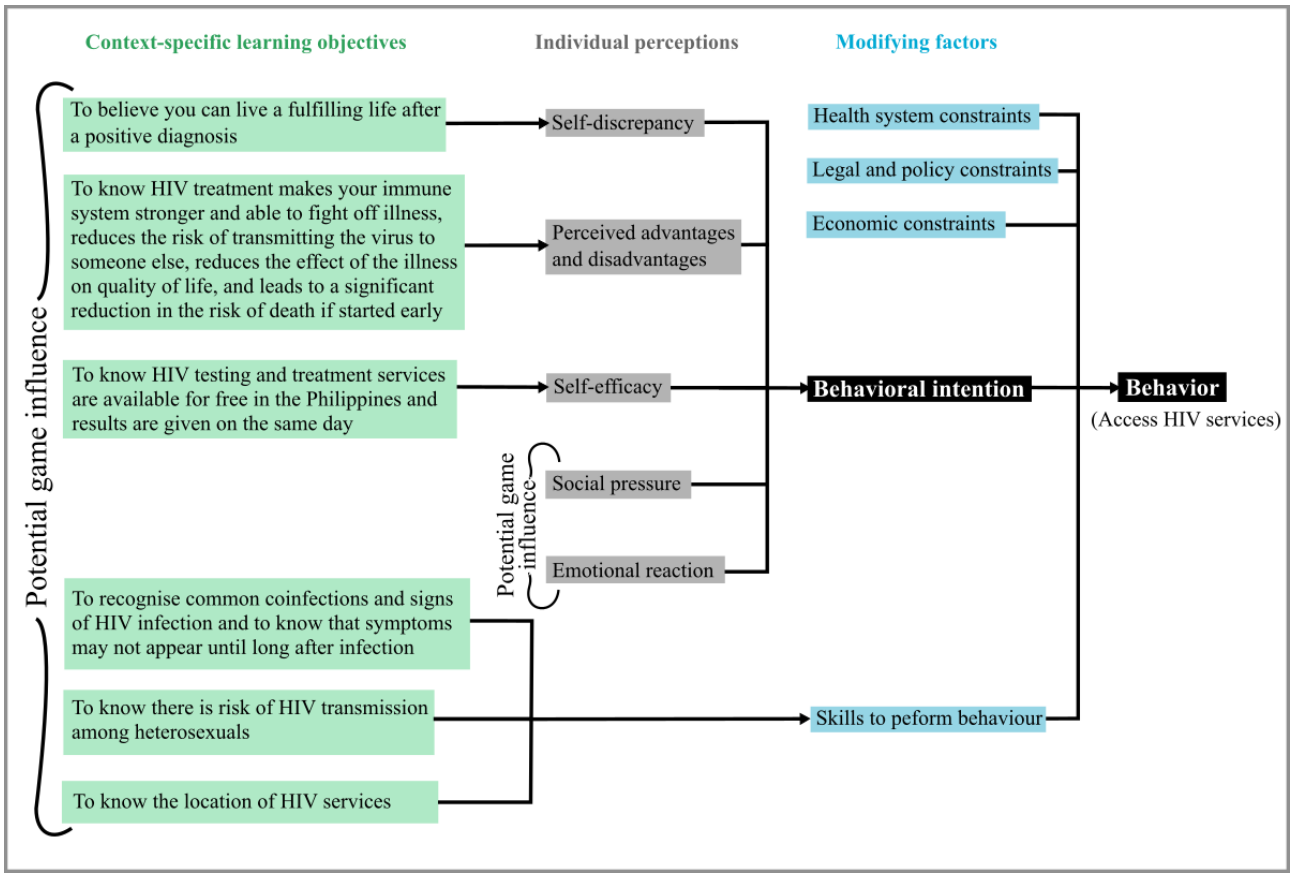
A Need for User-Centered Design in Games for Health

Rittel and Webber [19] defined the term *wicked problem* as a design problem that cannot be solved in a stepwise problem-solving manner. Game development is riddled with wicked problems. They are inherently interactive, and any interactive component must be tested with users. Even a simple game has an interconnected system as its backbone; any change to 1 component of the game will have ramifications to all connected components. Furthermore, game development is bound by countless budget, technical, user, and market constraints. As a solution to wicked problems, some game developers turned to user-centered design [20]. User-centered design is an iterative process; using a range of research techniques, feedback is obtained from users at different stages of product development to ensure their needs and preferences are considered in the design [21]. This design approach was established in the software industry to identify and rectify usability issues and expanded for use in game design to evaluate experiential aspects, supporting the development of games that are both functional and fun. User involvement in game design may have benefits with regard to the effectiveness of the game, although the evidence is mixed when reviewed in the context of games for healthy lifestyle promotion [22]. The core principle behind this theory is that, for a game to be effective, it must be acceptable and appropriate. This can only be achieved through

consultation with target users, especially if the developers do not share the same characteristics as them. User involvement is also predicted to improve user adoption and enable developers to critically reflect on the value and consequences of a game when vulnerable groups are involved [23]. Thus, user-centered design methods must encompass interpretation and emotional response to health-related content in the game as well as evaluating usability.

As the purpose of our game expanded beyond entertainment, we developed a theory of behavior change (Figure 1) to guide the design process [24]. Context-specific learning objectives were generated through a review of the literature and formative research with target users and HIV service providers in the regions of Davao and Manila. Data were collected through focus group discussions (FGDs) with HIV services providers, in-depth interviews with MSM and TGW, and an online survey on enablers and barriers to HIV services. Findings from the formative research are not included in detail in this paper. The framework references modifying factors relevant to the Philippines' HIV testing context such as health system and legal and economic constraints. Given that the target audience for the game will be young MSM and TGW, we do not expect the game to impact modifying factors but note that these are important considerations in the evaluation of the game's perceived effectiveness.

Figure 1. Integrative model of predictive behaviour and predicted game influence.



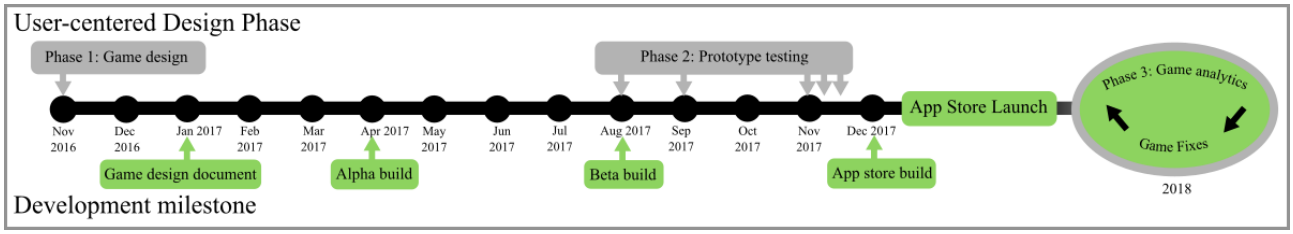
In this paper, we describe the user-centered design process for a mobile game titled *Battle in the Blood* and explore the effect of user-centered design techniques on the game's acceptability as a health intervention and uptake among target users.

Methods

Overview

Battle in the Blood was developed from 2016 to 2018 through a collaborative effort with experts from the United Kingdom and the Philippines. Final design choices were made by the game's coproducers: a British behavioral scientist specializing in game design for health system benefit (CH); the director of an independent game development company, with over 10 years industry experience, based in Scotland; and a Filipino clinical epidemiologist (EB). The process was divided into 3 phases and aligned with development milestones for the game (Figure 2). Internal playtests were frequently conducted by members of the project team and their immediate networks. Change requests and bugs were recorded and shared with the development team using Google Docs.

Figure 2. Development process.



Selection of User Centered Design Methods

A literature review was conducted to identify a range of user-centered design methods to be used in a combined approach. Methods were selected based on their fit to the question the development team wanted to answer and the available resources. The resulting design process involved a phased approach, with primary and secondary users engaged during the initial ideation and prototype testing stages. Resources were prioritized to capture important contextual requirements and evaluate educational and experiential aspects of the game. Selected methods included participatory design workshops [25], extended playtests [20], playability heuristics [26], FGDs, and game analytics.

As the methods for each phase were distinct, recruitment, data collection, and analysis have been described for each. Data were collected in the cities of Manila and Davao. The study was part of a much larger project, which included assessment of a rapid diagnostic algorithm for HIV, that was being piloted in these cities.

Phase 1: Game Design

To determine important contextual requirements and user preferences, design workshops with Filipino gamers were conducted during the initial specification and ideation stage. Subject experts in clinical practices for HIV and the Philippines HIV epidemic were allocated informant roles in the game development team.

Recruitment

Filipino individuals older than 18 years who regularly played digital games or were involved in game development or electronic sports, regardless of sexual identity, were invited to participatory design workshops via social networking sites, including Facebook and Steam forums. It was theorized that the game would need to be appealing and accessible to a range of gamer types and that gamer type would not be dictated by sexual identity. A total of 18 participants were divided into 2 groups (11 and 7). Participants were aged between 21 and 30 years and were a mixed group of MSM and non-MSM.

Data Collection

Group sessions were facilitated by UK and Filipino researchers (CH, EB, EG, and JD), in which (1) participants responded to questions by creating a human scatter graph indicating their level of agreement to different statements by their physical proximity to the statement placed on the floor, creating an instant visual of the group's perception and experience of mobile games and games for health; (2) group discussions were held on design and technical enablers and barriers to digital gaming; and (3) participants were divided into teams (maximum 6 participants in a team) to develop pitches for games to promote HIV services, which they then presented and discussed. HIV clinic counselors were present at both workshops to answer any questions the participants had regarding HIV and provided information on HIV service provision in the Philippines. The session was audio recorded and transcribed, and photos were taken to record the human scatter graphs and visuals from the game pitches.

Analysis

Transcripts and session outputs were analyzed using a framework approach [27] to identify a set of recommended game features. A 4-day workshop was conducted with the full development team to translate the list of recommended game features into a game design document. Game features were also connected to the context-specific learning objectives outlined in Figure 1.

Phase 2: Prototype Testing

Playtesting sessions and FGDs were conducted to assess the acceptability and playability of the beta game build.

Recruitment

Participants were older than 18 years and self-identified as MSM. This study aimed to ensure that the narratives and art style were appealing, relatable, and inoffensive to the target users. Participants were recruited using social networking sites, including Facebook, Grindr, Growlr, and PlanetRomeo, known as popular networking sites for the MSM and TGW community. Peer counselors from HIV testing services were also recruited as they were predicted to be an important user group for the game.

Overall, 5 FGDs and playtesting sessions involving a total of 22 participants were conducted between August 20, 2017, and November 18, 2017; 4 sessions were conducted in Manila (17 participants, all MSM) and 1 in Davao (5 participants, all peer counselors and MSM). Game changes and bug fixes were implemented between each testing session.

Data Collection

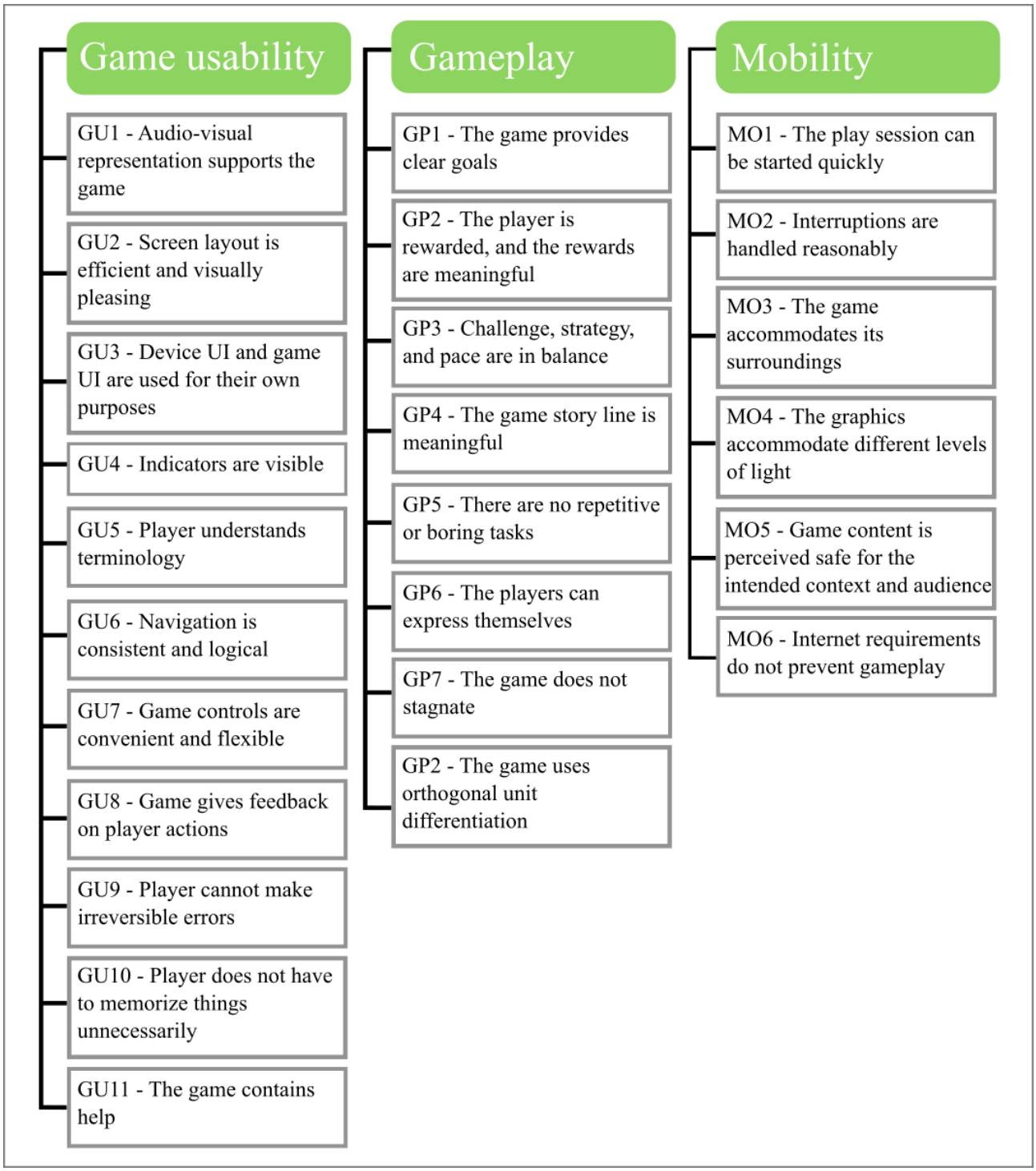
Sessions were facilitated by UK and Filipino researchers (CH, EB, EG, and JD). User testing was divided into 3 activities: (1) participants' screens and faces were video recorded as they played the game for 30 to 45 min, (2) all animations in the game were played on a big screen and a short discussion was held by participants for each one, and (3) a group discussion was conducted on the perceived acceptability of the game.

Analysis

Analysis of data from the game testing sessions was divided into 2 parts. The first part utilized playability heuristics to

identify and fix design flaws. Playability heuristics are a set of qualities by which a game's engagement and usability can be assessed. They are typically used by game developers and professional game testers. We adapted an existing list of playability heuristics for mobile games [26] to use as a coding framework to analyze the video recordings and transcripts (Figure 3). Screen recordings were primarily used to identify technical and usability issues, whereas transcripts were more conducive to recognizing different experiential aspects. For example, expressions of confusion by the player when they lost a level, especially when followed by repeated failed attempts, could be marked as a violation of gameplay heuristic GP1, "the game provides clear goals" (Figure 3). This is an example of what is termed a playability violation. Playability reports were developed independently by 2 researchers (CH and EG). The reports described each playability violation and gave recommendations for game improvements. The reports were compared and discussed by the game development team before agreeing on a final list of game changes. Where feasible, changes were implemented before the next game testing session. Software bugs and technical issues were also recorded, and fixes were implemented.

Figure 3. Playability heuristics for mobile game for health. UI: user interface.



The second part of the data analysis utilized the transcription of the group discussions to assess the acceptability of the game as a health intervention. Data analysis was informed by a general inductive approach, aligning emerging themes identified in the transcripts with the following predetermined constructs of health intervention acceptability: affective attitude, burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness, and self-efficacy [28].

Quality Assurance: Phases 1 and 2

All qualitative data collected were translated into English for analysis (EG), and the translation was checked for accuracy by members of the research team. Analysis was led by a UK researcher (CH) with regular consultation and input from the full project team to improve quality and depth. All design choices resulting from the data were reviewed by the development team before implementation.

Phase 3: Game Analytics

Recruitment

Game use data were obtained from users who installed the game and gave permission for the app to access device storage. Geolocation data were obtained from users who granted access to their devices' location data and played the game with GPS switched on. Information about why data were being gathered and reassurances that all data would be kept anonymous were presented on the app store page, and in the game when access was requested.

The game was made available on the Apple App Store and Google Play on November 27, 2017, and was officially launched during World AIDS Day celebrations in the Davao Region on December 1, 2017. Marketing events for the game included local television appearances by project staff, printed and online news articles, exhibitions at health- and game-related conferences in the National Capital Region and Davao Region, social media advertisements on Facebook and Twitter, and posters displayed in 4 HIV testing and counseling clinics (3 in Manila and 1 in Davao). The game analytics span a 12-month period from December 1, 2017, to December 1, 2018.

Data Collection

Data were automatically gathered from devices with the game installed through the Unity Analytics service, version 2017.1 by Unity Technologies. For data to be sent from the device, the user must have opened the game at least once while the device was connected to the internet. Events are stored locally on the device when the game is played offline and sent the next time the game is opened and the device is connected. All data points were stored in the Unity Data Store. The game metrics (Table 1) were exported and converted into a readable format for use in statistical analysis software.

Table 1. Game metrics.

Segment	Metrics
Active player metrics	Daily active users; monthly active users; and new users (unique device installs)
Session metrics	Sessions per day; sessions per user; total daily playing time; and total playing time per active user
Retention metrics	Day 1, 7, and 30 retention
Platform segment	Total Android and iOS users
Custom segments	Level events—reports each time a level is completed or failed, and the players end score; link event—reports the click-through rate of all in-game links to external information; question events—reports the response to all in-game questions, including a set of demographic questions; geolocation per session—reports the device's current location at the start of a session to 2 decimal places; and app version

Analysis

Descriptive statistical analysis was conducted in Microsoft Excel, version 1812. Spatial analysis was conducted in QGIS, version 3.2.3.

Ethical Assurance: All Phases

Legal advice was sought to ensure that management of game analytics complied with the 2018 European Union General Data Protection Regulation.

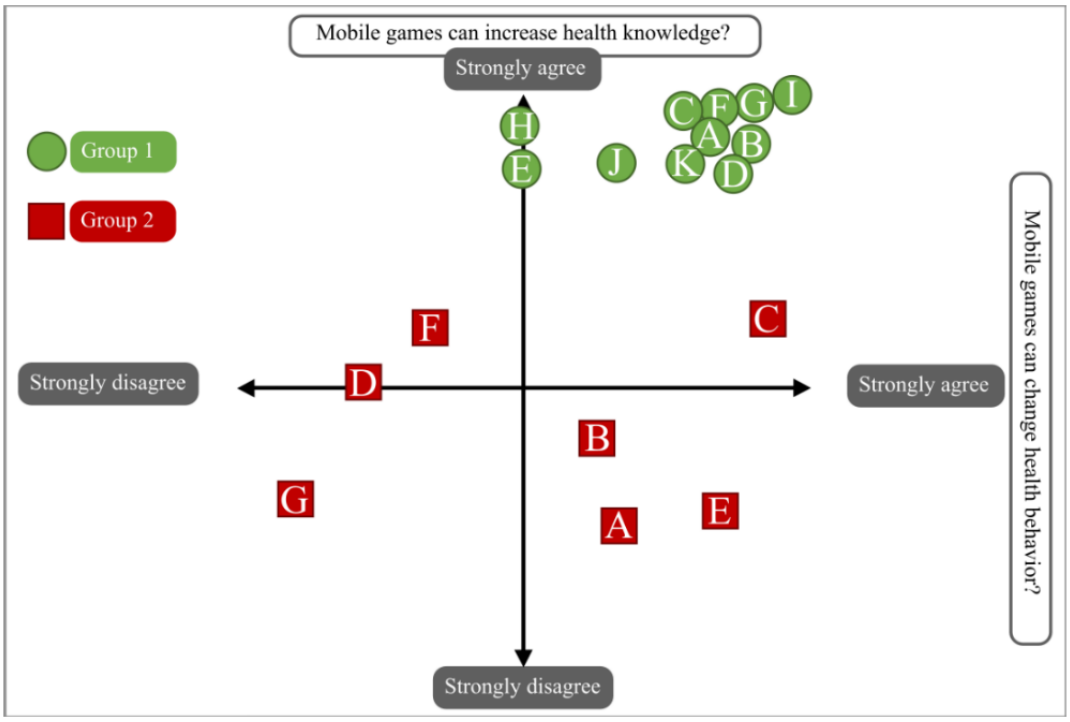
Ethical approval for the project was obtained from the ethics committees at the University of the Philippines College of Medicine and Liverpool School of Tropical Medicine (research protocol 16-017).

Results

Phase 1: Game Design

Direction on game elements to support health-related behavior change first emerged through the human scatter graph activity. Figure 4 demonstrates that the 2 groups had varied perceptions on the effectiveness of games for health-related behavior change. Participants were questioned as to why they had chosen their place on the graph. Perceived limitations of the game's effectiveness were centered around beliefs that changes in knowledge would not be sufficient to change behavior and that the use of technical language would make the game's content inaccessible, as illustrated by the following quote:

Figure 4. Human scatter graph on perceptions of the effectiveness of games for health behavior change.



> *I'm still not convinced with the knowledge part because, as with some health conditions, even with some health benefits and stuff, there will be some things that a player will not understand, especially if it's scientific jargon...but I do believe that behavior can change especially if it's immersive and it is an experience that will change your perspective on very different matters.* [Group 2: Respondent B]

Facilitators to behavior change centered around the use of immersive experiences that could change perspectives and generate social interactions between users, as illustrated by the following quote:

> *Because whenever I'm playing games, they would often ask me "Hi [name]! What's that game? Is that available in iOS? Is it available in the Android Play Store?" Right after I told them about it, they would go check out the game and download it. So, it's not just me but also them that learns from the game.* [Group 1: Respondent J]

During group discussion, the game's narrative was identified as an important feature. If done well, it fostered an identification with the game characters and motivated the players to overcome challenges in the gameplay to witness the story unfold. The narrative was identified as the logical place to communicate why it was important to know one's HIV status. Participants felt that the game should not provide technical information on HIV or HIV services but should focus on telling an emotionally driven story and provide the player choice over the narrative direction.

When the groups were divided into teams (2 teams in each group) to pitch their HIV advocacy games, 3 out of the 4 teams presented a similar concept of a hero sent on a quest to fight or evade the HIV virus, where story and role-playing game (RPG) elements intertwined and where reality and fantasy existed in the same space.

Multiplayer gameplay was reported to be a strong motivator for repeated gameplay and was perceived to play a role in the effectiveness of the game, as illustrated by the following quote:

> *...they say that no man is an island. So, I think it would affect the behaviour of the person if there is a community that pushes you. Someone playing alone will say "I'm just alone, nobody will care if I do this or do that." But if you know somebody else is pushing you, it will affect your behaviour, it drives you as a person.* [Group 1: Respondent I]

However, participants also reported that access to these types of games was restricted because of the requirement of a stable internet connection:

> *I have external and internal factors why I leave the game. The external factor is whenever the game requires internet connection because the internet, the wireless data in the Philippines is not that good.* [Group 1: Respondent E]

This presented a dilemma for the game design. On the one hand, multiplayer gameplay was a very desirable game style among the participants as they could participate in discussions about HIV, behavior, and personal values and coconstruct their own narratives about a desired future. This was further evidenced by the market success of multiplayer mobile games in the Philippines. On the other hand, we did not have the resources to develop and maintain an online multiplayer platform, and known issues around internet connectivity would restrict access to the game.

Combining Feasibility With Desire

Findings from the phase 1 game design workshops directed the game's overarching narrative and the integration of gameplay and storytelling. Players take on the role of the protagonist, entering the blood stream in an antiretroviral (ARV) pill capsule and battling anthropomorphic viruses, bacteria, and cancer cells using a weaponized mechanical suit. The gameplay combines match-3 puzzles with turn-based combat; players connect icons on a puzzle board that represent condoms, ARVs, healthy living, health care, and time. Connecting the icons builds up the player's defense and attack status during the rounds of combat. The match-3 game style was selected because of the availability of prebuilt game assets and source code, which substantially reduced the development time and enabled the team to allocate time to the custom animations.

The gameplay is segmented with a series of 8 animated stories about people living with HIV that the player helps by progressing through the game. The difficulty of the levels and the types of enemy units are connected with the story line. For example, if the character in the story line is diagnosed with gonorrhea, an enemy unit representing gonococcus appears during the gameplay. In the game's final mission, the player is introduced to a character with AIDS in critical condition; it is revealed that he has never been tested for HIV, treatment fails, and the character dies. Throughout the game, the player is awarded with fragments that combine to form an anting-anting, a traditional Filipino amulet believed to have magical powers. This amulet allows the player to travel back in time and change how the story ends for this character by encouraging him to undergo a HIV test.

The game can be played and completed offline. Online features include a global leader board, ranking players by their total score, and hyperlinks to websites containing information on HIV and HIV services in the Philippines. The file size of the game was also restricted to 53.4 MB on Android and 70 MB on iOS to reduce the risk of failed download attempts from the app stores. This in turn had ramifications for animations and sounds in the game, both of which can substantially increase the file size. To maintain a small file size, the number of sound effects and music tracks in the game was limited and animated stories were presented in a dynamic 2-dimensional comic book style, where static images moved across the screen to give the scenes depth and movement.

Integration of Context-Specific Learning Objectives

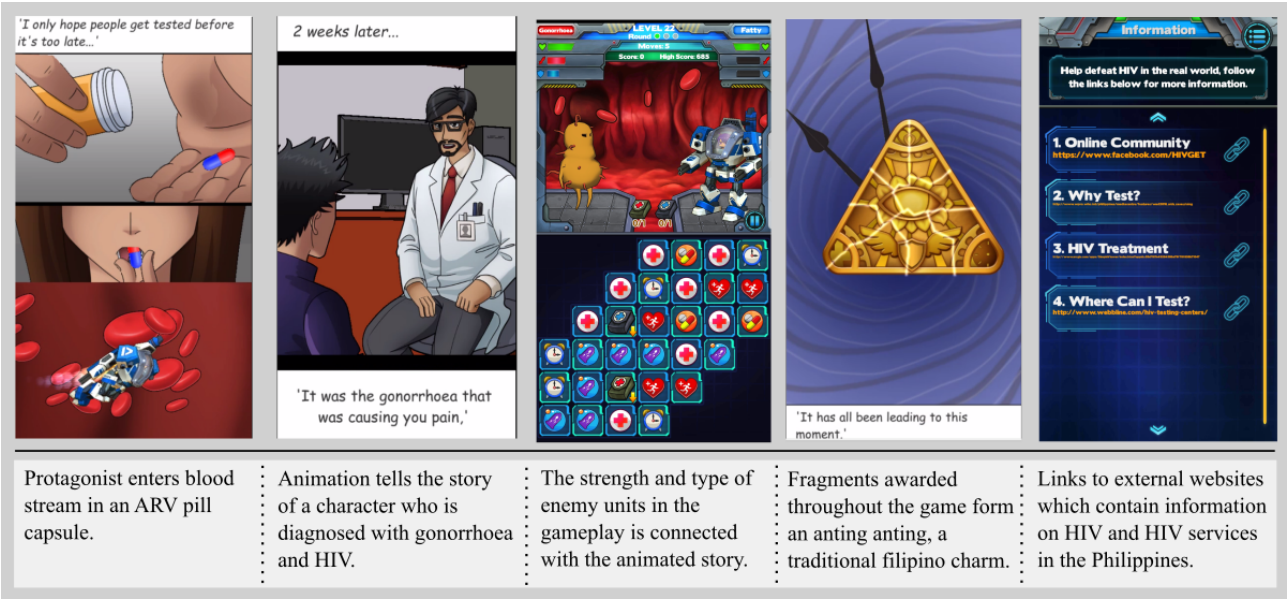
Table 2 details the design choices made in relation to the context-specific learning objectives outlined in Figure 1.

Figure 5 uses screenshots from the game to illustrate some of the design choices made. A table summarizing the phase 1 design process (Multimedia Appendix 1) and the game design document, version 0.15, (Multimedia Appendix 2) are included as Multimedia Appendices.

Table 2. Theory of behavior change design choices.

Context-specific learning objective	Game design element
To believe that you can live a fulfilling life after a positive diagnosis	The animated stories depict people living with HIV pursuing their ambitions, being socially active, or spending time with their family. For example, a transgender character enters a beauty pageant and, as she takes her medication in the dressing room, the text reads, "I fought to be my true gender, I can win this fight too." This particular story line was selected because of the cultural relevance pageantry has in the Philippines and the great esteem in which Filipinos hold the contestants.
To know that HIV treatment makes your immune system stronger and more able to fight off illness; reduces the risk of transmitting the virus to someone else; reduces the effect of the illness on quality of life; and, if started early, leads to a significant reduction in the risk of death	Antiretroviral tablets feature in every animated story except the one where the character dies. Treatment is also shown to improve the physical appearance of the characters in the later missions. Players can earn an extra life during gameplay by answering a multiple-choice question. Some questions address knowledge on treatment effects, and feedback containing the right answer is given. Hyperlinks to websites containing information on HIV treatment are included throughout the game, and the click-through rate is measured.
To know that HIV testing and treatment services are available for free in the Philippines and that results are given on the same day	In the animated stories, the words "Free HIV tests" appear in the background of all the clinic waiting room scenes. The rapid testing procedure is depicted in the first 3 animations. Multiple-choice questions address the availability of free testing and the time taken for the client to receive their results in the Philippines. Hyperlinks to websites containing information on HIV services in the Philippines are included throughout the game, and the click-through rate is measured.
To recognize common coinfections and signs of HIV infection and to know that symptoms may not appear until long after infection	Enemy units in the game include representations of gonorrhea, tuberculosis, hepatitis B, herpes, and cancer. Common signs of HIV infection are depicted in the animated stories, and some characters show no symptoms.
To know that there is a risk of HIV transmission among heterosexuals	The first animated story depicts a heterosexual couple. In several other animated stories, the character's sexuality is ambiguous.
To know the location of HIV services	A hyperlink to a website containing the contact information and location of all testing sites in the Philippines is featured throughout the game.

Figure 5. Screenshots Battle in the Blood v1.4.



Phase 2: Prototype Testing

Table 3 summarizes the final agreed list of playability violations and the game changes made as a result.

Learning Achieved Predominantly Through Interpretation of the Animated Narratives

Participants repeatedly drew inferences between the presence of ARVs and the positive outcome in the short-animated stories, recognizing the unique benefits of treatment for each character, as illustrated by the following quote:

> *Ever since the guy was given the ARVs, his fear of him having STDs or socializing with people is now gone, and he was able to not be afraid to connect with other people.* [GameTester_MSM]

Table 3. Playability violations and game changes.

Playability heuristic	Evidence of violation	Game change
GP5: There are no repetitive or boring tasks	Participants felt bored and disengaged with the animation when the first half of the story line was repeated. Video footage demonstrated that players did not realize they could skip the recap by tapping anywhere on the screen.	On the second playthrough, a title screen appears with the text "Previously on *Battle in the Blood*…Skip?"
GU1: Audio-visual representations support the game	Players reported the icons as unintuitive because the color of the icons did not correspond with the combat status bars that they effected. Video footage showed players taking decisions based solely on the length of the chain, not the color of the icons, and becoming frustrated when they repeatedly lost a level.	The design of the icons was adjusted to correspond visually with the attack and defense bars.
GU11: The game contains help	Participants did not feel that the onboarding was comprehensive enough, and new mechanics in the game were not explained.	When a new game mechanic is triggered, a dialog box appears that explains the new mechanic using a small amount of text and images. This information can also be accessed via the game's menu and via the level-pause screen.
GP6: The players can express themselves	Participants stated that they did not like the mechanical suit as they had spent time customizing the avatar but rarely saw it in the game as most of it was covered.	Avatar appears animated in the level-complete or -fail screen.
GP2: The player is rewarded, and the rewards are meaningful; GP5: There are no repetitive or boring tasks	Participants stated that they wanted to be able to earn in-game currency by completing the levels, which could be spent on upgrading or customizing their character. They also felt this would make the gameplay feel less repetitive.	Implementing an in-game currency system and custom character upgrades would have required additional resources and delayed the planned launch of the game. The change request was logged but not implemented for the pilot.

In addition to the inferred benefits of HIV treatment, participants also identified messages about the consequences of delayed access to HIV services. One participant reported that the game had changed his personal understanding of when to undergo a HIV test, as shown by the following conversation:

> *For me it's better to test at the earliest, so you can know if you're positive and prevent it earlier.* [PhaseTwo_GameTester_MSM]
>
> *So, before you played the game, you just know that you need to get tested when?* [Interviewer]
>
> *Only if you're already having symptoms.* [PhaseTwo_GameTester_MSM]

Participants interpreted the stories based on their current knowledge and personal values. In 1 case, this led to the message of the story being repeatedly challenged:

> *...he was told that he has Gonorrhoea and he was then given pills to cure it and the HIV treatment. With that, he told himself that this could save his life and then could continue living his life normally. And then he was seen to be at the bar again. But it was somehow an off for me because it gave me the impression that just because there's treatment, you can go on with your promiscuous activity all your life.* [PhaseTwo_GameTester_MSM]

Some counterarguments were expressed because of preexisting knowledge, namely, a lack of awareness that ARVs can reduce the viral load to the point where the individual is no longer infectious and social norms in which sexual promiscuity is perceived as an undesirable trait. Most participants concluded that the character in this particular animation was sexually promiscuous because the story centered around a nightclub, and he was diagnosed with HIV and gonorrhea. In this case, the narrative appeared to challenge stigmatizing perceptions around sexual promiscuity and its association with HIV.

Although participants felt that the health-related messages were reinforced in the turn-based combat levels, most of the learning outcomes were achieved through interpretation of the animated narratives and the discussions they triggered. A potential concern is that the animations were perceived to be disconnected from, and less engaging than, the gameplay. During the prototype testing session, all in-game animations were played in sequence through a projector, and participants intently watched and discussed each animation. Interpretation of the narrative may be significantly different by a user casually playing the game alone, with no direct incentive to focus on and analyze the content.

Identification With Game Characters

Animated narratives where the players shared a set of commonalities with the character diagnosed with HIV elicited a stronger emotional reaction than those where the characters did not share similar demographics or behaviors. The story of a young MSM who resorts to solicitation to afford to play games at an internet café was reported to be the most impactful story line by almost all game testers. This was likely because of the recruitment strategy, as most game testers were part of the young MSM community and had a strong interest in gaming:

> *Well it seems relatable for me because I'm a gamer. And I have a friend who does that thing sometimes. And thankfully he hasn't got any HIV. It's relatable to me because well, I know those who did, I experienced one but thankfully I haven't got HIV.* [GameTester_MSM]

The game follows the stories of 8 different characters diagnosed with HIV. Each character is unique in its sexuality, gender, appearance, and behavior. Therefore, a user is likely to empathize with or relate to some but not all characters in the game. As game characters are presented in a predetermined sequence, some users may never witness a character that they share commonalities with, reducing the potential impact of the in-game narrative for certain users based on their progress in the game. The representation of different sexualities and genders was well received by participants as they acknowledged that it could help to address misconceptions that HIV only effects MSM, indicating that the design flaw was the delivery of the narratives rather than the inclusion of multiple character types.

Gameplay Perceived as Enjoyable but Potentially Limited in Appeal

Despite a positive response from the participants, in which gameplay was described as "enjoyable, addictive, and challenging," there were indications that the game would have a limited appeal. In the first instance, participants had very low expectations for the game and expressed surprise at playing a game comparable with commercial games on the app stores. In 1 FGD, participants identified 2 categories of gamers, casual and hardcore, and discussed which category the game would appeal to and why. A casual gamer was perceived to be someone who occasionally engaged with digital games as a form of distraction, whereas a hardcore gamer's life would revolve around digital games. Most agreed that the game would have little to no appeal for hardcore gamers. For casual gamers, the consensus was that the game would be appealing but required an effective marketing and deployment strategy to overcome competition from similar games. Offline gameplay was perceived to be a strong motivator, regardless of gamer type, as it would enable players to alleviate boredom when they were unable to access features on their devices that required an internet connection. Marketing *Battle in the Blood* as a game about HIV was perceived to have 2 effects on the appeal; in most cases, it would arouse curiosity or tap into a desire to learn, whereas in some cases, it could be off-putting. Participants felt that the game's marketing should also be targeted toward parents and should offer information on the age appropriateness of the content.

Phase 3: Game Analytics

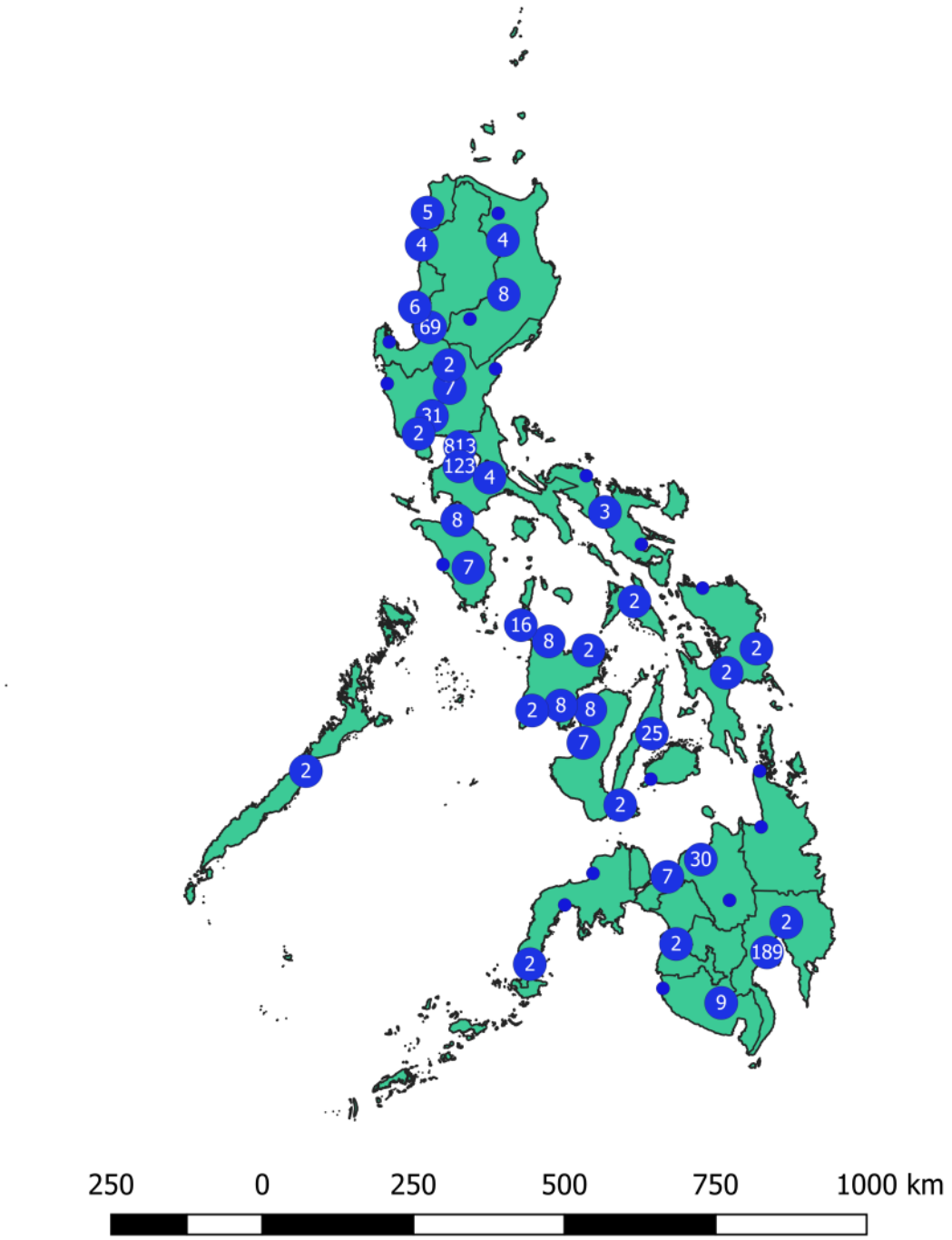
Game analytics reported 3325 unique device installs globally during a 12-month period. The game received an average of 10 installs per day. Installs peaked during active and incentivized marketing events; the maximum number of installs in 1 day was 367 at the time of the World AIDS Day launch event in Davao.

Unity Analytics provided a more accurate report of game uptake and reach than the app store services because of the common practice of using third-party apps, such as SHAREit, to access the game via Bluetooth and avoid data costs. Installs via this method would not have been captured by the analytics services provided by the Apple App Store or Google Play at the time of the study.

Regional Game Uptake

Geolocation data were collected for at least one play session from 50.77% (1688/3325) of users. Of the users from whom geolocation data were collected, 85.36% (1441/1688) were located in the Philippines (Figure 6). Game use was concentrated in urbanized areas. Uptake of the game was highest in the National Capital Region and Davao Region. Furthermore, 54.01% (1796/3325) of the users reported their age, gender, and gender of sexual partners; of these users, 28.06% (504/1796) reported as being sexually active MSM. Within the sexually active MSM category, 47.8% (241/504) reported their age as between 25 and 34 years, 26.1% (132/504) as between 20 and 24 years, and 7.1% (36/504) as between 10 and 19 years.

Figure 6. Cluster point map of the location of Battle in the Blood installations in the Philippines. Points clustered at 4mm. Number in circle represents total number of users which installed Battle in the Blood in that location. Total number of user records from the game analytics that contain geolocation data and have played the game in the Philippines=1441. Region level shape file from Humanitarian Data Exchange.



Overall, 2 factors are believed to have contributed to the substantially higher uptake among target users in the regions of Davao and Manila. First, several promotional exhibitions for the game were held by project staff in these regions. The exhibitions often included prize giveaways for those who downloaded the game, indicating a dependency on these types of active and incentivized marketing events. Self-reported data indicated that marketing events targeting adolescent users were potentially lacking. Second, user-centered design activities were conducted in these regions with influencers in both the gaming and HIV community, and it is likely that they also played a role in promoting the game.

Low Rates of Game Completion

As of December 1, 2018, 14.98% (498/3325) of users were reported to have completed level 45 and 4.00% (133/3325) were reported to have completed level 90, the last level in the game. Factors believed to have contributed to the reported low rates of game completion are the gameplay being perceived as repetitive and having limited appeal and missing data because of the provision of offline gameplay.

Additional factors impacting uptake and progression will be explored further through interviews with end users and follow-up interviews with participants involved in the design process.

Identification of Access Issue on Android Devices

Game analytics and app store reviews were monitored throughout the 12-month period. Monitoring activities supported the identification of an access issue on Android devices, which was related to app permissions managed by the Google Play store. A fix was launched on November 5, 2018. Between October 5, 2018, and November 4, 2018, the average number of daily active users was 16, and this increased to 40 in the month following the fix.

Discussion

Establishing Design Solutions Through User-Centered Design

User-centered design methods supported the identification of contextual requirements for the game [22]. Qualitative methods provided a deep understanding of the important factors that both motivated and enabled gameplay, which are likely to have contributed to the reported uptake and use of the game. The human scatter graph method and game pitches enabled participants to reflect on their views and the views of others, which, in turn, ignited valuable discussion on the qualities the game required to both be appealing and deliver persuasive health messages. Although findings from phase 1 influenced the creative direction of the game, each design choice made by the development team was prefixed with a discussion on what was feasible within the predetermined budget and development time frame. For example, during phase 1, an action RPG in which the player could control their character's strength and traits was found to be highly desirable, but adequate resources were not available to implement a stable and balanced underlying mathematical model for this feature. In this case, the design workshops supported the identification of a wicked problem, the solution for which was informed by the experience and best judgment of the game's coproducers [19]. The reported low rates of game completion indicated that optimal design solutions were not achieved by the game's producers.

User-Centered Design and Community Adoption

Results from the game analytics indicated that users' involvement in the game development process had a positive impact on uptake among target users. However, the extent of that impact cannot be determined from the available data. For example, although unique device installs were substantially higher in regions where user-centered design activities took place, the proportion of installs credited to such activities cannot be determined, especially with the presence of targeted and incentivized promotional events in those regions. Further studies are recommended to explore the correlation between user involvement and community adoption of games for health. The way in which target users involved in the design are credited may also be an important factor to consider.

Narratives in Games for Health

Storytelling has long been established as an effective means of attitude and behavior change [17], and this was reflected in the findings during the user-centered design process. This also highlights the importance of having an experienced narrative designer as part of the development team to work in partnership with the subject domain and behavioral experts. Assessment of the game's acceptability found that mobile game design that accommodates typical user behavior is not always conducive to effective storytelling. To be suitable for use in a public space, the animated stories had to be highly captivating to retain focus while also allowing the player to disengage without missing vital information. Although *Battle in the Blood* made some headway in delivering a narrative that was accessible and accommodated typical user behavior, a lack of interaction, an obscure link to the gameplay, delivery through linear episodes, and limited character identification may have rendered the animated stories ineffective in generating new knowledge and perceptions when the game is played outside a facilitated gameplay session. These design flaws could be addressed through the inclusion of additional branching narratives driven by player choice, forming a stronger link between the gameplay and cause and effect sequences in the narrative, inclusion of stories based on true events, allowing players to select narratives they are interested in, and facilitating group gameplay sessions where players are encouraged to discuss their interpretation of the narratives as part of the game's distribution strategy.

Multiple Data Collection Methods to Mediate Biases

Telemetry and geolocation data are widely used in the mobile games industry to improve app revenue. There are countless articles ranking key performance indicators by their value to app developers. In response to demand, a range of services are now available that process large volumes of data into actionable information with very low setup costs. In the case of the Unity Analytics service (version 2017.1), standard metrics can be obtained by toggling a switch in the Unity game engine. Although generating income may not be a primary goal, it could be argued that analytical services that capture data during

gameplay are currently underutilized in games for health development and evaluation [29]. In contrast to FGDs, telemetry and geolocation data collected through the game are not biased by the presence of a researcher; however, emotive responses to gameplay cannot be captured this way. Thus, it is important not to focus solely on 1 data collection technique but rather to triangulate results from a range of different data sources to mitigate bias while providing a more complete picture of game performance.

This study explored the effect of user involvement on health intervention acceptability and community adoption and described in detail the methods used. Further evaluation of the game has been conducted to explore the game's effect on knowledge, attitudes, and HIV service use among target users, the results of which will be published in a separate paper.

Limitations

As with all qualitative research, findings cannot be applied to the wider population with certainty. Perceptions from aged under 18 years and subjects outside Manila and Davao were not captured. Although the project team failed to recruit TGW during phases 1 and 2 of the game development process, they were included during the formative research stage, which informed the conceptual framework for the game (Figure 1). Feedback on how the transgender character in the game was portrayed was provided by TGW known to the research team in the Philippines in an informal capacity.

The authors note that the recruitment strategy and use of FGDs is likely to have resulted in a bias toward participants less encumbered by stigma toward their sexuality or HIV status. Given that recruitment advertisements stated that participants would be inputting into the design of an HIV advocacy game, this may have also created a bias toward individuals with a vested interest in health advocacy and game design.

The timing for phase 2 protype testing was not ideal, which is believed to have impacted the changes implemented in the game design.

Certain terms used by the participants did not have a direct English translation, which, at times, led to ambiguity in the data during the translation process.

Conclusions

By involving users from the outset, the development team was guided toward narratives that were shown to be relatable and understandable and to gameplay that provided enjoyment. The resulting product is a game that is accessible, simple, and entertaining because of universally recognized game mechanics, small file size, and offline gameplay. At a minimum, games for health should involve target users in early stages of the design process as a relatively cost-effective method of cataloging important contextual requirements and user preferences. If target users are to be tasked with developing design solutions, then interaction with the development team must go beyond FGDs. For the target user to be a valued member of the game development team, they must have adequate expertise in design, a shared goal, and be properly credited and compensated for their contributions [22]. Increased reporting of design approaches and stronger collaboration among health professionals, the entertainment games industry, and end users will support the games for health industry as it matures. Restructuring projects to involve users before determining the development budget will enable design choices to be driven more by user requirements and less by what is feasible.

Acknowledgments

The authors wish to acknowledge the game development team at EM Studios and Bobby Farmer (coproducer), Craig Gardiner (lead artist), Aitor Prado (lead coder), and Stuart Henderson (coder), whose hard work and passion were integral to the project. The authors would like to thank all the participants who devoted their time to partake in the study, and the authors would also like to acknowledge the contributions made by the Philippines Department of Health's National HIV and Sexually Transmitted Infection Prevention Program, LoveYourself Philippines, Klinika Bernardo-Quezon City Health Office, Davao Social Hygiene Clinic-Davao City Health Office, Dr Rhoda Myra Garces-Bacsal, Dr Jose Gerard Belimac, Dr Stefanie Gregorius, and Dr Marlize Coleman. This project was funded by the Newton Agham Grant through the UK Medical Research Council and Philippines Council of Health Research and Development, Department of Science and Technology.

Authors' Contributions

CH analyzed the data and wrote the manuscript. CH and EB produced the game. All authors inputted into the study design, game design, data analysis, and manuscript. EG and TS coordinated the recruitment and data collection activities and transcribed and translated the data.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Summary of phase 1 design process.
[DOCX File , 18 KB-Multimedia Appendix 1]

Multimedia Appendix 2

Battle in the Blood game design document v0.15.
[DOCX File , 3318 KB-Multimedia Appendix 2]

References

1. The Joint United Nations Programme on HIV/AIDS. UNAIDS Philippines Country Factsheet. URL: https://www.unaids.org/en/regionscountries/countries/philippines [accessed 2017-12-01]
2. Bumanglag KC. Enhancing HIV/AIDS surveillance in the Philippines to ensure the transgender population's visibility. Am J Public Health 2018 Jan;108(1):58-60. [doi: 10.2105/AJPH.2017.304158] [Medline: 29211538]
3. Department of Health website. 2015. Integrated HIV behavioral and serologic surveillance: 2015 fact sheet. URL: https://www.doh.gov.ph/sites/default/files/publications/Philippines_2015_IHBSS_Fact_Sheets_Nov2017_22JUN2016.pdf [accessed 2017-12-01]
4. Department of Health website. 2016. The State of the Philippine HIV Epidemic 2016 Facing Challenges, Forging Solutions. URL: https://www.doh.gov.ph/sites/default/files/publications/publication__nonSerials_State%20of%20HIV%20Epidemic%20in%20the%20Philippines.pdf [accessed 2017-12-01]
5. AIDS Data Hub. 2018. HIV / AIDS and ART Registry of the Philippines. URL: http://www.aidsdatahub.org/hivaids-and-art-registry-philippines-march-2018-epidemiology-bureau-department-health-2018 [accessed 2017-12-01]
6. Wong VJ, Murray KR, Phelps BR, Vermund SH, McCarraher DR. Adolescents, young people, and the 90-90-90 goals: a call to improve HIV testing and linkage to treatment. AIDS 2017 Jul 1;31(Suppl 3):S191-S194 [FREE Full text] [doi: 10.1097/QAD.0000000000001539] [Medline: 28665876]
7. Adia A, Bermudez A, Callahan M, Hernandez L, Imperial R, Operario D. 'An Evil Lurking Behind You': drivers, experiences, and consequences of HIV-related stigma among men who have sex with men with HIV in Manila, Philippines. AIDS Educ Prev 2018 Aug;30(4):322-334. [doi: 10.1521/aeap.2018.30.4.322] [Medline: 30148671]
8. van Wijngaarden JW, Ching AD, Settle E, van Griensven F, Cruz RC, Newman PA. 'I am not promiscuous enough!': exploring the low uptake of HIV testing by gay men and other men who have sex with men in Metro Manila, Philippines. PLoS One 2018;13(7):e0200256 [FREE Full text] [doi: 10.1371/journal.pone.0200256] [Medline: 29979766]
9. Canoy NA, Ofreneo MA. Struggling to care: a discursive-material analysis of negotiating agency among HIV-positive MSM. Health (London) 2017 Nov;21(6):575-594. [doi: 10.1177/1363459315628040] [Medline: 26851265]
10. Burki T. HIV in the Philippines. Lancet Infect Dis 2017 Jun;17(6):589-590. [doi: 10.1016/S1473-3099(17)30256-6] [Medline: 28555587]
11. Koirala S, Deuba K, Nampaisan O, Marrone G, Ekström AM, CAT-S group. Facilitators and barriers for retention in HIV care between testing and treatment in Asia-A study in Bangladesh, Indonesia, Lao, Nepal, Pakistan, Philippines and Vietnam. PLoS One 2017;12(5):e0176914 [FREE Full text] [doi: 10.1371/journal.pone.0176914] [Medline: 28459881]
12. KPMG Global. 2018. IT Report: Philippines Investment Guide. URL: https://home.kpmg/ph/en/home/insights/2017/12/it-report-philippines.html [accessed 2017-12-01]
13. Newzoo. 2017. The Filipino Gamer. URL: https://newzoo.com/insights/infographics/the-filipino-gamer/ [accessed 2017-08-20]
14. Hightow-Weidman LB, Muessig KE, Bauermeister J, Zhang C, LeGrand S. Youth, technology, and HIV: recent advances and future directions. Curr HIV/AIDS Rep 2015 Dec;12(4):500-515 [FREE Full text] [doi: 10.1007/s11904-015-0280-x] [Medline: 26385582]
15. DeSmet A, van Ryckeghem D, Compernolle S, Baranowski T, Thompson D, Crombez G, et al. A meta-analysis of serious digital games for healthy lifestyle promotion. Prev Med 2014 Dec;69:95-107 [FREE Full text] [doi: 10.1016/j.ypmed.2014.08.026] [Medline: 25172024]
16. Prensky M. Fun, play and games: what makes games engaging. In: Digital Game-Based Learning. United States: Paragon House; 2001:1-31.
17. Shen F, Han J. Effectiveness of entertainment education in communicating health information: a systematic review. Asian J Commun 2014;24(6):605-616. [doi: 10.1080/01292986.2014.927895]
18. Kort YA, IJsselsteijn WA, Poels K. Digital games as social presence technology : development of the Social Presence in Gaming Questionnaire (SPGQ). In: Presence 2007 : the 10th Annual International Workshop on Presence. Barcelona: Starlab; 2007:1-9.
19. Rittel HW, Webber MM. Dilemmas in a general theory of planning. Policy Sci 1973;4(2):155-169. [doi: 10.1007/BF01405730]
20. Pagulayan R, Keeker K, Fuller T, Wixon D, Romero R, Gunn DV. User-centered design in games. In: Sears A, Jacko JA, editors. Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications. Boca Raton: CRC Press; 2007:883-906.
21. Giacomin J. What is human centred design? Des J 2014;17(4):606-623. [doi: 10.2752/175630614X14056185480186]
22. DeSmet A, Thompson D, Baranowski T, Palmeira A, Verloigne M, de Bourdeaudhuij I. Is participatory design associated with the effectiveness of serious digital games for healthy lifestyle promotion? A meta-analysis. J Med Internet Res 2016 Apr 29;18(4):e94 [FREE Full text] [doi: 10.2196/jmir.4444] [Medline: 27129447]

23. Mayer I, Bekebrede G, Harteveld C, Warmelink H, Zhou Q, van Ruijven T, et al. The research and evaluation of serious games: toward a comprehensive methodology. Br J Educ Technol 2014;45(3):502-527. [doi: 10.1111/bjet.12067]
24. Conner M. Cognitive determinants of health behavior. In: Steptoe A, editor. Handbook Of Behavioral Medicine: Methods And Applications. New York, NY: Springer; 2010:19-30.
25. Jessen S, Mirkovic J, Ruland CM. Creating gameful design in mHealth: a participatory co-design approach. JMIR Mhealth Uhealth 2018 Dec 14;6(12):e11579 [FREE Full text] [doi: 10.2196/11579] [Medline: 30552080]
26. Korhonen H, Koivisto EM. Playability Heuristics for Mobile Multi-player Games. In: Proceedings of the 2nd international conference on Digital interactive media in entertainment and arts. 2007 Presented at: DIMEA'07; September 19-21, 2007; Perth, Australia p. 28-35.
27. Smith J, Firth J. Qualitative data analysis: the framework approach. Nurse Res 2011;18(2):52-62. [doi: 10.7748/nr2011.01.18.2.52.c8284] [Medline: 21319484]
28. Sekhon M, Cartwright M, Francis JJ. Acceptability of healthcare interventions: an overview of reviews and development of a theoretical framework. BMC Health Serv Res 2017 Jan 26;17(1):88 [FREE Full text] [doi: 10.1186/s12913-017-2031-8] [Medline: 28126032]
29. Smith SP, Blackmore K, Nesbitt K. A meta-analysis of data collection in serious games research. In: Loh CS, Sheng Y, Ifenthaler D, editors. Serious Games Analytics: Methodologies for Performance Measurement, Assessment, and Improvement. Switzerland: Springer International Publishing; 2015:31-55.

Abbreviations

ARV: antiretroviral
FGD: focus group discussion
MSM: males who have sex with males
RPG: role-playing game
TGW: transgender women

Edited by G Eysenbach; submitted 25.02.19; peer-reviewed by P Newman, T Kuhn, F Mckay, J Salisbury; comments to author 27.04.19; revised version received 18.06.19; accepted 19.08.19; published 20.12.19

Please cite as:
Hemingway C, Baja ES, Dalmacion GV, Medina PMB, Guevara EG, Sy TR, Dacombe R, Dormann C, Taegtmeyer M
Development of a Mobile Game to Influence Behavior Determinants of HIV Service Uptake Among Key Populations in the Philippines: User-Centered Design Process
JMIR Serious Games 2019;7(4):e13695
URL: http://games.jmir.org/2019/4/e13695/
doi: 10.2196/13695
PMID: 31859673